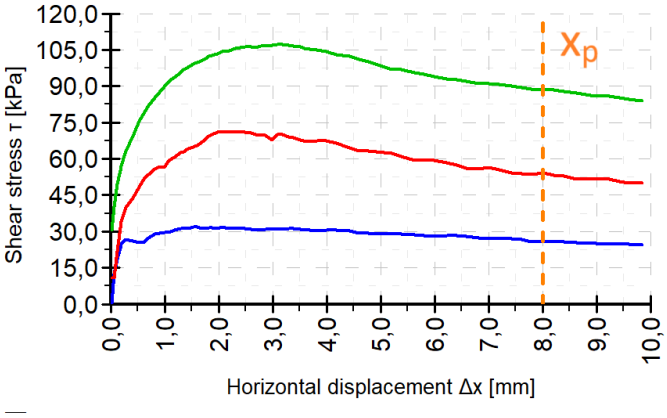
Editing a Template in the Laboratory Program

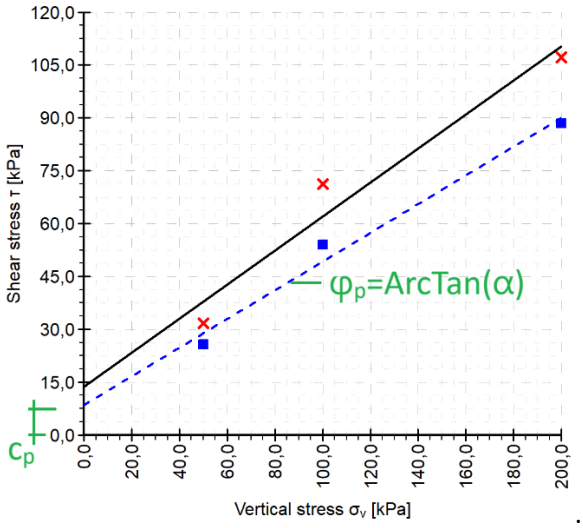
Program: Laboratory
File: Demo_manual_52.gsg

This manual describes advanced work with formulas and graphs in templates using the example of editing the Shear Box Test. **Basic formula work is explained in Engineering Manual No. 51. This manual requires the knowledge covered in Manual No. 51.**

Our goal is to determine the values of the angle of internal friction φ_p and cohesion c_p at any point during the test (for the displacement specified by us at the test point x_p).
In our case, we will consider $x_p = 8\ mm$.
The calculation procedure is the same as for the standard peak strength. From the stress graph of individual tests, we read the stress values at point x_p.



We then fit a straight line through the obtained points and calculate the values φ_p and c_p.



Note: We usually look for the stated value of the shear parameters in the part of the test beyond its peak in an attempt to find residual shear strength parameters. However, since the shear box test is not suitable for determining the actual residual parameters, we present the derived shear parameters for the selected deformation.

Output report of the shear box test of the template set "Laboratory - EN-Standard" has the following form:

GEO5 Laboratory

Shear Box Test

Project: Apartment building "Moonlighting" - Survey for building permit

Test ID: Shear box test	Project ID: 2022/3548
Supplier: GEO5 Laboratory Ltd.	Customer: Survey ABC Ltd.
Date of measurement: 27.03.2023	Performed by: John Young

Sample

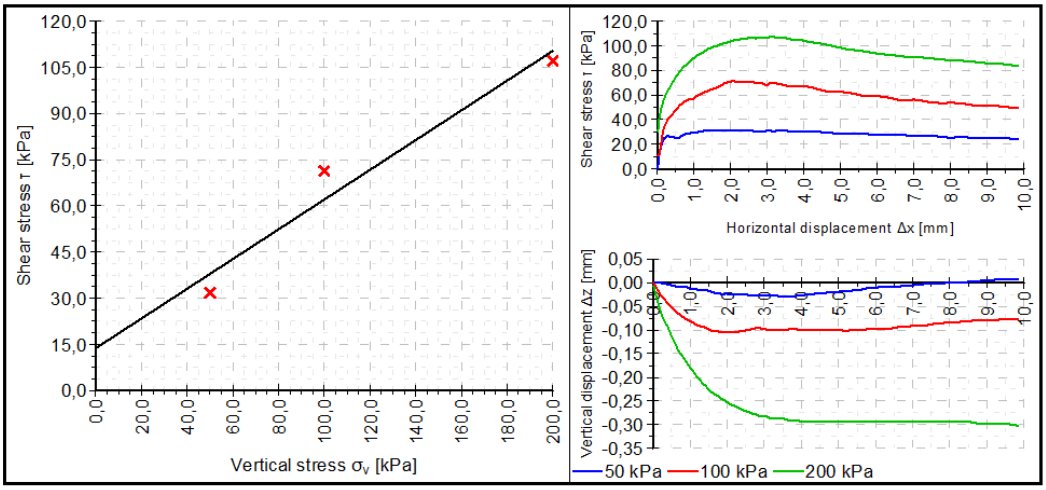
Field test: BH5	Sample type: undisturbed
Sample index: VA1/1254	Geotechnical type: GT2
Depth from: 7,00 m	Description:
Depth to: 7,80 m	Clay with low plasticity, stiff, gray-blue color

Specimen

Specimen ID: VA1/1254-12	Consolidation time: 24,0 hour
Depth: 7,35 m	Shear rate: 0,001 mm/min

	Before test	Specimen Nr. 1	Specimen Nr. 2	Specimen Nr. 3
Dimensions (width/height) [mm]	-	60,00 / 21,00	60,00 / 21,00	60,00 / 21,00
Moisture content [%]	22,45	24,40	24,30	22,10
Consolidation (before test) [mm]	-	0,210	0,550	1,170
Vertical stress [kPa]	-	50	100	200
Max. shear stress [kPa]	-	31,7	71,3	107,2
Wet unit weight [kg/m^3]	1802,0	1848,0	1921,0	1967,0
Dry unit mass [kg/m^3]	1472,2	1485,5	1545,4	1610,9
Displacement at failure [mm]	-	1,530	2,061	3,080

Measured values and results



Test results:	Angle of internal friction φ_{ef} [°]	Cohesion c_{ef} [kPa]
Peak values:	25,8	13,8

Notes

Specimens were flooded with water during the test. Moisture content indicated for the test specimens is after the end of the test (moisture content determined according to EN ISO 17892-01).
Specimen supplied by the customer, test results refer to the sample as received. Test equipment: hydraulic shear device. Test performed in accordance with EN ISO 17892-10.

Verified by: Peter Filmer | **Date of issue:** 28.03.2023 | Stamp and signature

The required form of the protocol is this:

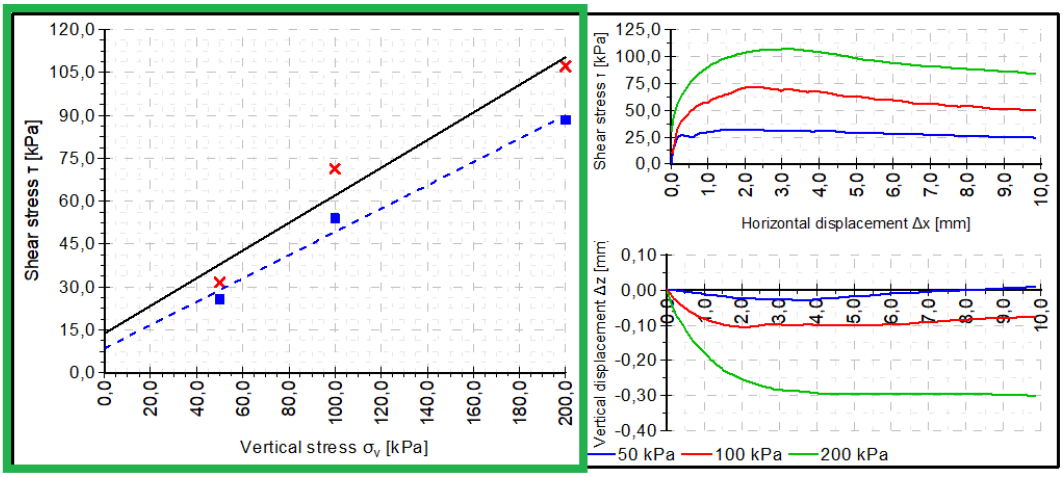
GEO5 Laboratory	**Shear Box Test**
	Project: Apartment building "Moonlighting" - Survey for building permit
Test ID: Shear box test	Project ID: 2022/3548
Supplier: GEO5 Laboratory Ltd.	Customer: Survey ABC Ltd.
Date of measurement: 27.03.2023	Performed by: John Young

Sample	
Field test: BH5	Sample type: undisturbed
Sample index: VA1/1254	Geotechnical type: GT2
Depth from: 7,00 m	Description:
Depth to: 7,80 m	Clay with low plasticity, stiff, gray-blue color

Specimen

Specimen ID: VA1/1254-12		Consolidation time: 24,0 hour		
Depth: 7,35 m		Shear rate: 0,001 mm/min		
	Before test	**Specimen Nr. 1**	**Specimen Nr. 2**	**Specimen Nr. 3**
Dimensions (width/height) [mm]	-	60,00 / 21,00	60,00 / 21,00	60,00 / 21,00
Moisture content [%]	22,45	24,40	24,30	22,10
Consolidation (before test) [mm]	-	0,210	0,550	1,170
Vertical stress [kPa]	-	50	100	200
Max. shear stress [kPa]	-	31,7	71,3	107,2
Wet unit weight [kg/m^3]	1802,0	1848,0	1921,0	1967,0
Dry unit mass [kg/m^3]	1472,2	1485,5	1545,4	1610,9
Displacement at failure [mm]	-	1,530	2,061	3,080

Measured values and results



Test results:	**Angle of internal friction φ_{ef} [°]**	**Cohesion c_{ef} [kPa]**
Peak values:	**25,8**	**13,8**
Post peak values at displacement 8,0 mm:	**22,1**	**8,5**

Notes

Specimens were flooded with water during the test. Moisture content indicated for the test specimens is after the end of the test (moisture content determined according to EN ISO 17892-01).
Specimen supplied by the customer, test results refer to the sample as received. Test equipment: hydraulic shear device. Test performed in accordance with EN ISO 17892-10.

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Solution:
Edit the template with the demo file - Demo01.gla, which you can find in Fine online examples. Name the newly created template set EM 52 and save it in the Template Administrator for further use. We introduce the term “Post peak parameters” for the required parameters within the solution of this manual.

We will divide the solution of the problem into several parts:

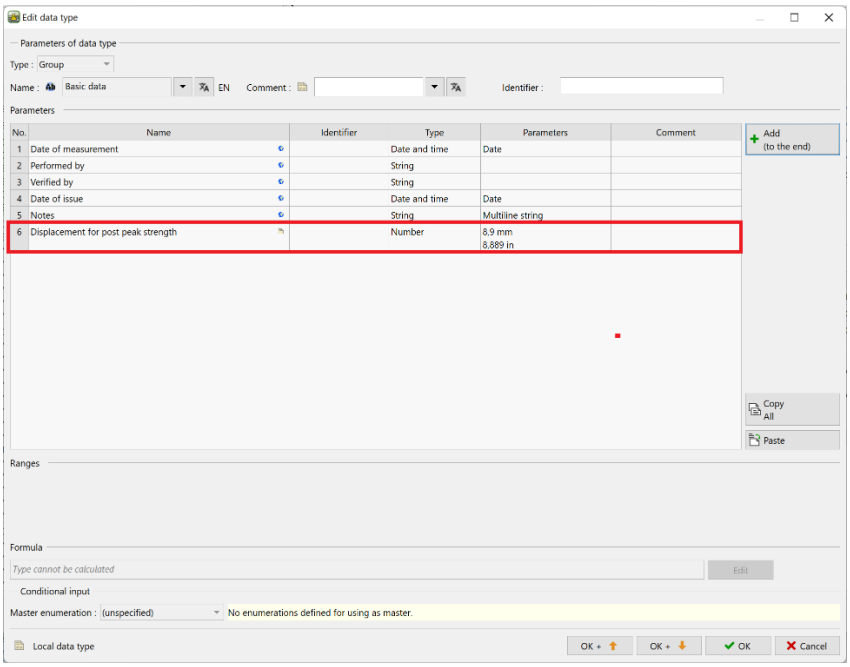
1. Define the data type “Displacement for post peak strength” and fill in its value
2. Define other data types needed for calculation and plotting in the graph
3. Input formulas for automatic calculations
4. Edit the output log and desktop preview to include the new data

Part 1
First, open the Demo01.gla file, which contains the data we will be working from. In the Templates frame, check if we have set the template set we want to edit – “Laboratory - EN-Standard”. Press the “Edit copy of current template set and add it into the Administrator” button to open the template set editing window.

Assign a name to the created set of templates and save it in the administrator as a user template.

Open the template for the shear box test and add a new local data type into the “Basic data” group, name it **“Displacement for post peak strength”** and assign the following parameters:

- Type: Number
- Unit type: length
- Name: Displacement for post peak strength
- Symbol: -
- Empty text: -
- Metric unit: mm, 1 decimal place
- Imperial unit: in, 3 decimal places

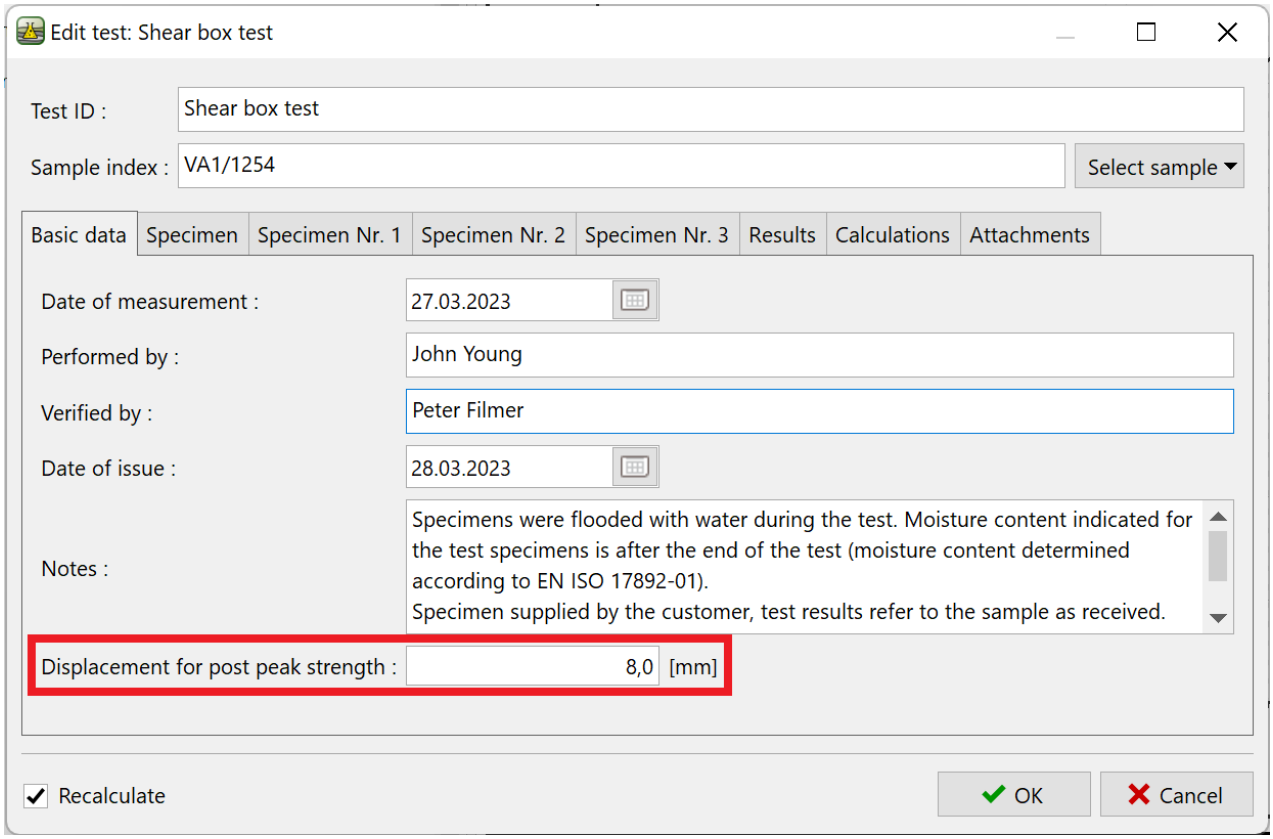


Note: Creating local data types and basic work with templates is described in detail in Engineering Manual 51.

Save the edited template and proceed into the “shear box test” frame and open the already input test.

In the window, we see a new field for the data type we created, “Displacement for post peak strength”. We will fill in 8 mm according to the specifications. We will then use this value in further calculations.

Note: by having this value already filled in, we will see previews of specific calculations when creating formulas. This will make our work easier.



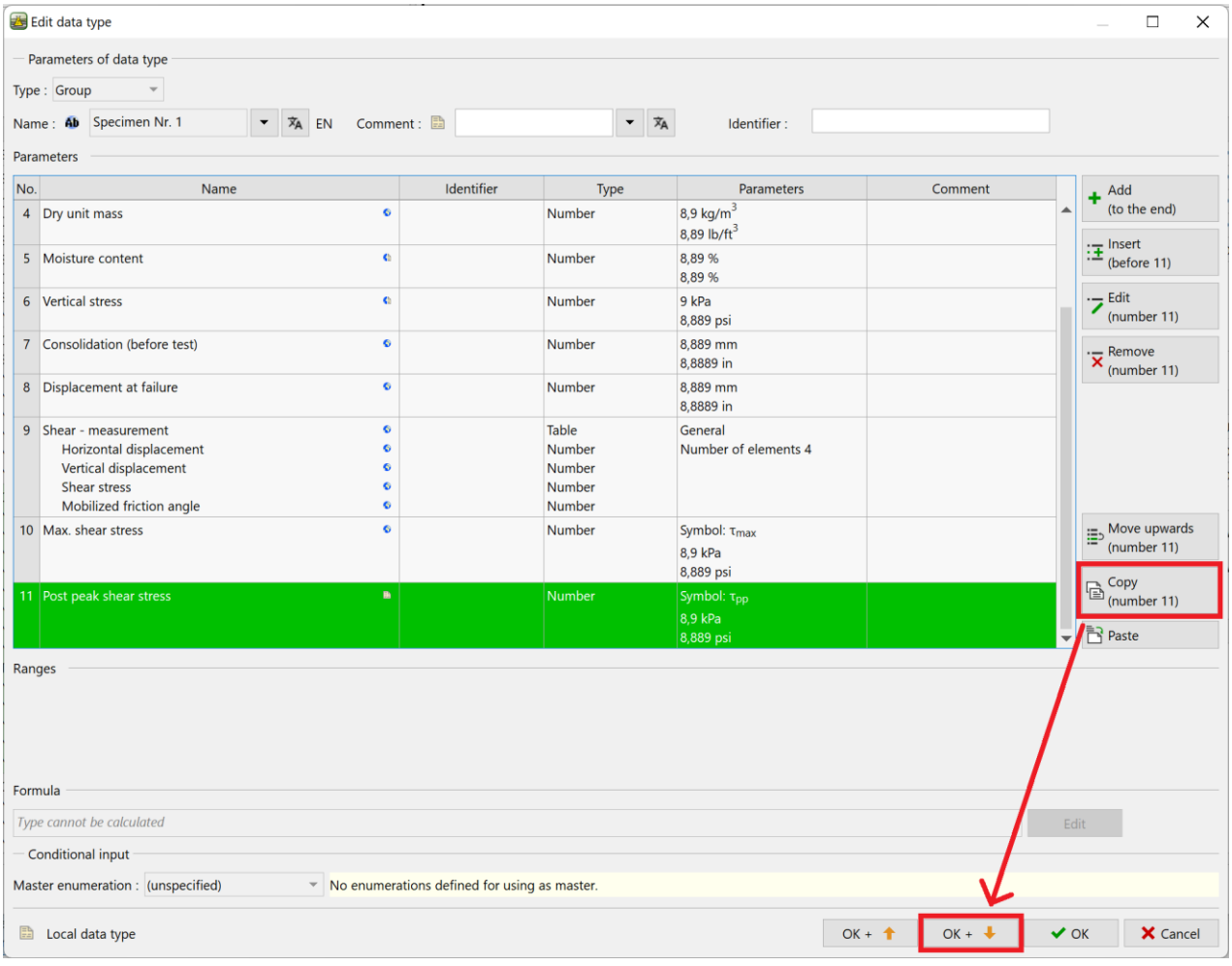
Part 2

Now return to the template modification and into group “Specimen Nr. 1” add another local data type “Post peak shear stress” with the following parameters:

- Type: Number
- Unit type: pressure
- Name: Post peak shear stress
- Symbol: τ_{pp}
- Empty text: -
- Metric unit: kPa, 1 decimal place
- Imperial unit: psi, 3 decimal places

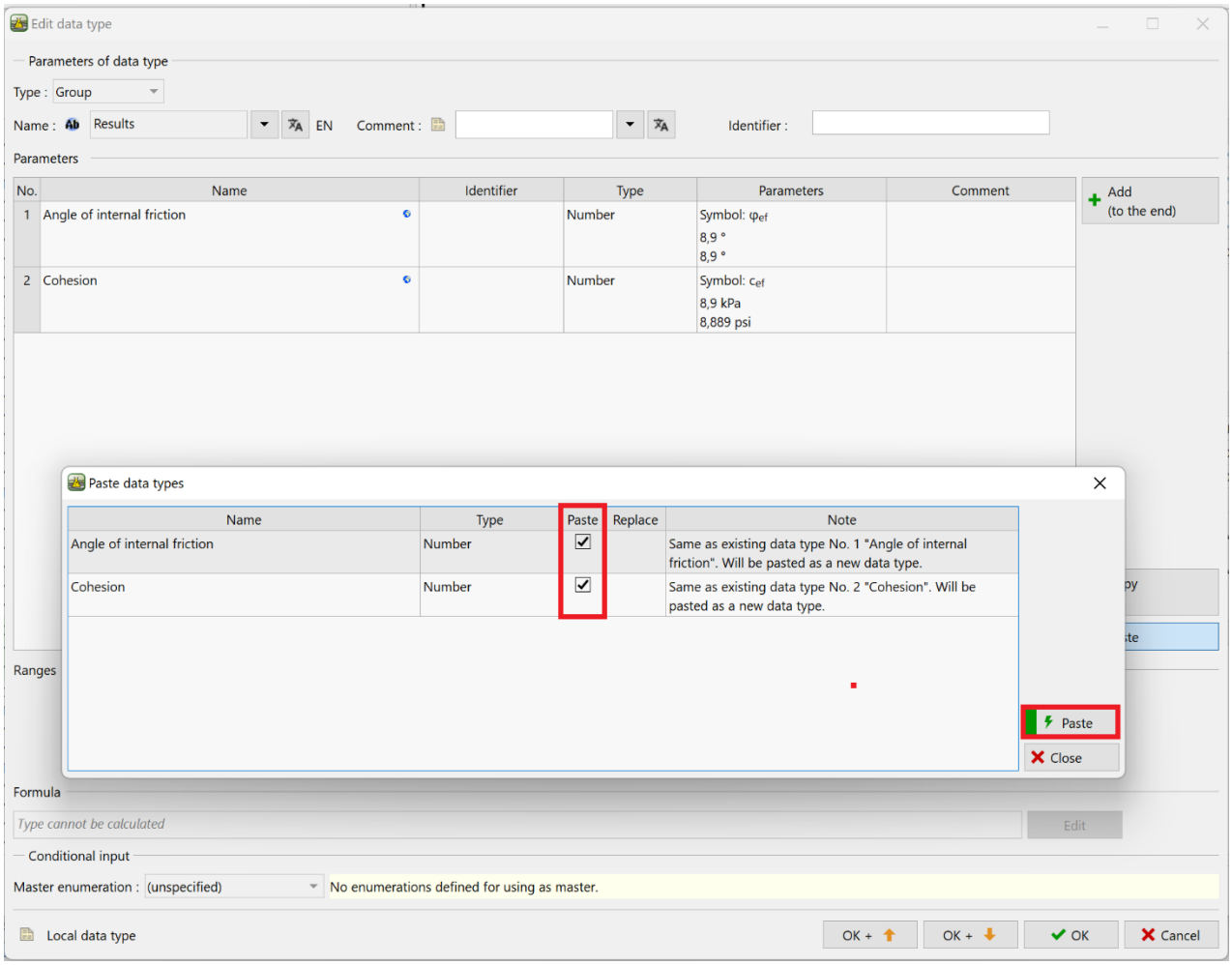
This data type will not be entered by the user, but we will assign a formula to it for automatic calculation.

We need the same data type in the group for specimens 2 and 3. To save ourselves the work, we can now copy the created item and press the “OK + down arrow” button to go straight to the “Specimen Nr. 2” group, where we simply paste the item.

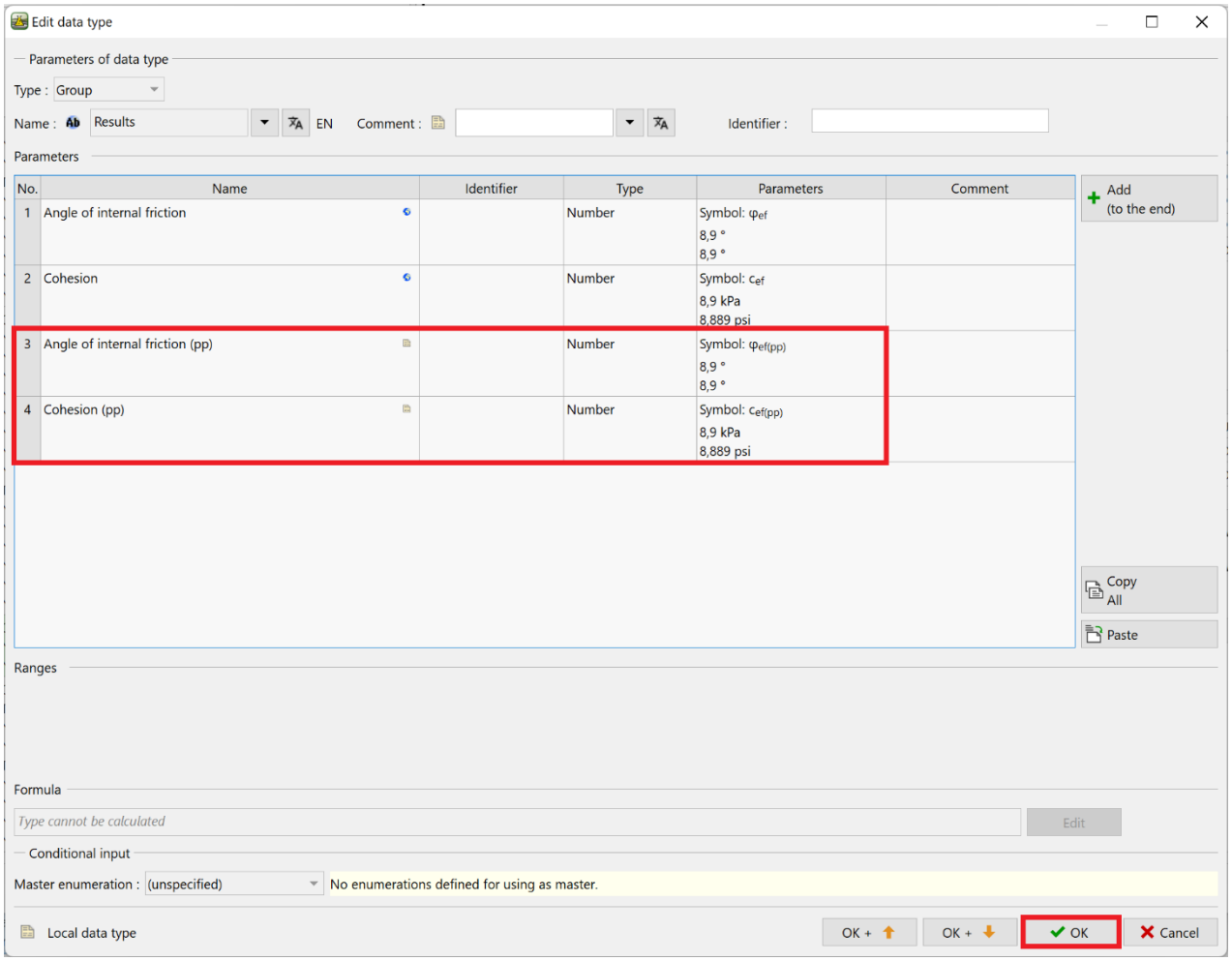


Continue by also pasting it into the group “Specimen Nr. 3”.

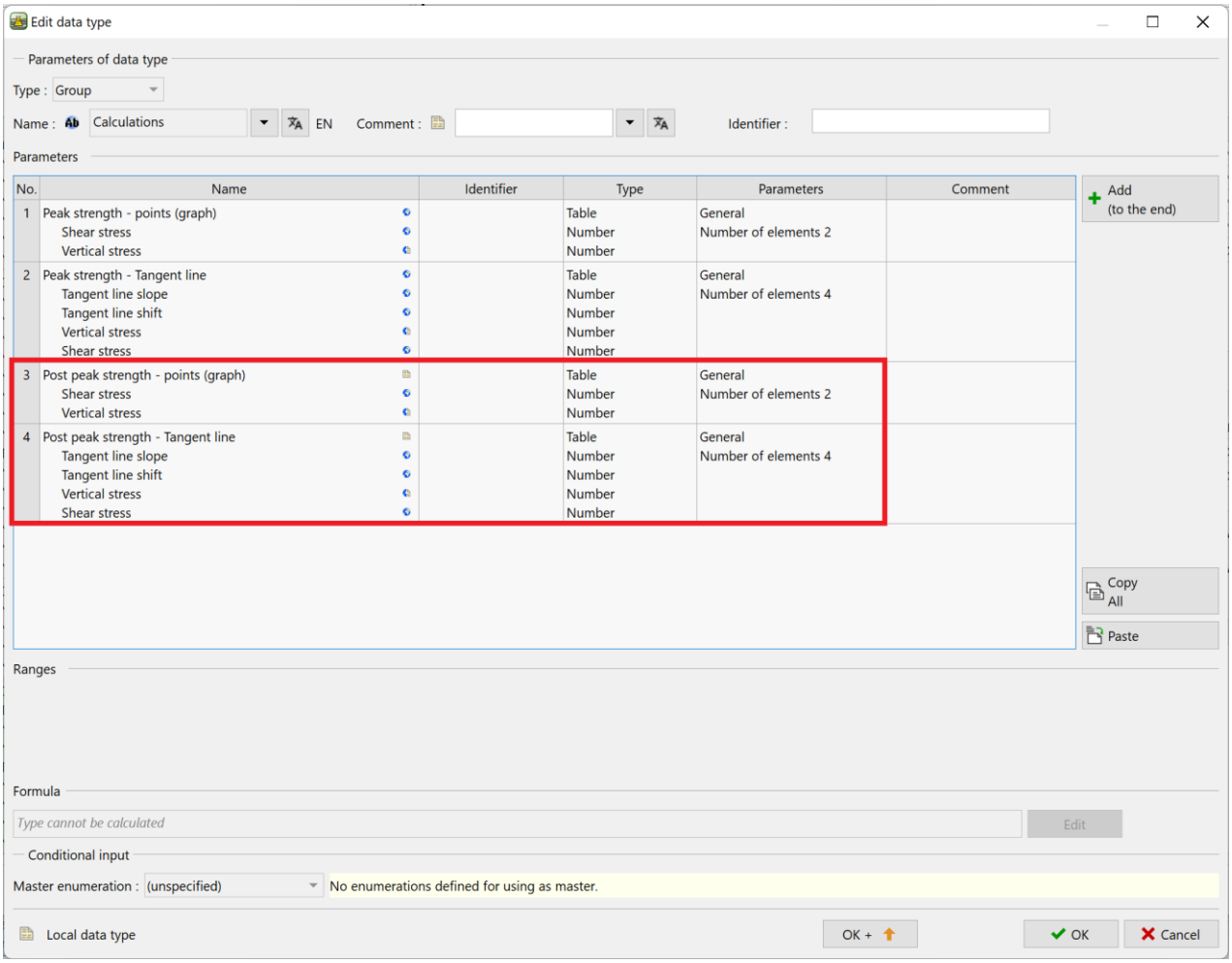
Next, we continue by creating data types for the calculations and output logs. In the “Results” group we already have two data types for the results in the peak values. We can now copy and then re-paste these two data types into the same group. The program will warn us that the same data types are already in the group, yet we select to paste them again.



Now simply open the newly added items and edit the name and symbol, e.g. by adding “(pp)”, referring to post peak strength.



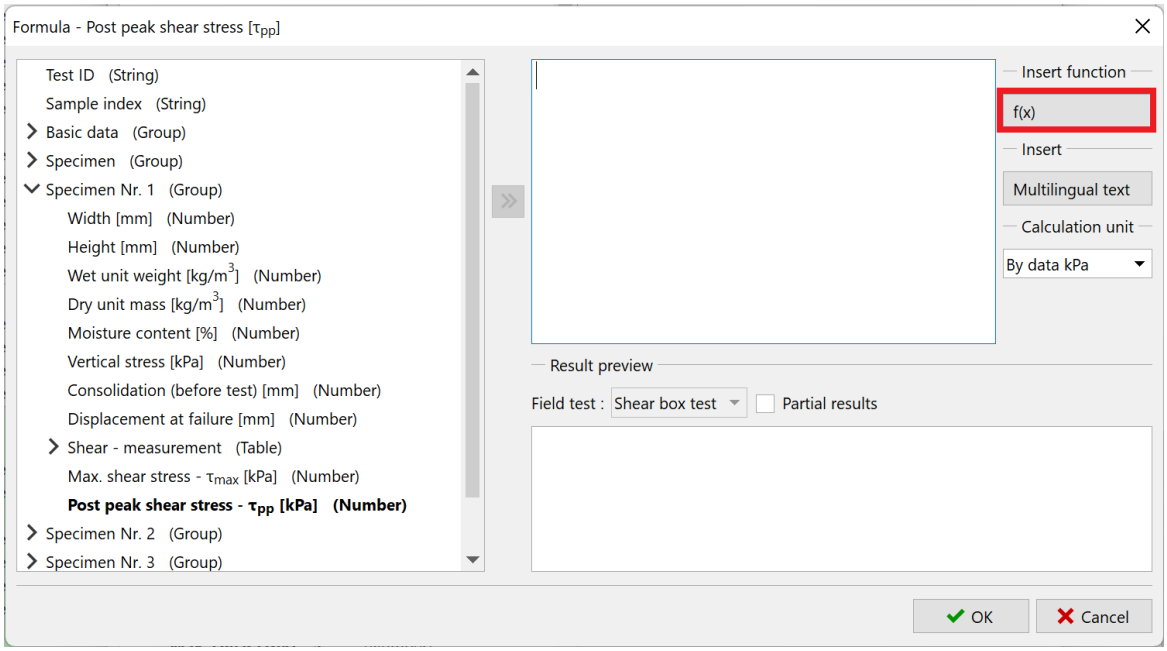
In the same way, copy the tables in the “Calculations” group - and name them “Post peak strength”.



Part 3
Now we will continue by entering the formulas.

Note: Basic work with formulas is explained in Engineering Manual 51.

In the tree, find the newly created data “Post peak shear stress” under the group “Specimen Nr. 1” and open the window for adding the formula. Here we press the button to add a function.



The basic version of the shear box test template works with the "Shear - Measurement" table, in which the user enters the Horizontal displacement, vertical displacement and shear stress. For the peak parameters, the maximum entered shear stress is considered. In the task specification, we have defined that we will consider the surface parameters for the specified horizontal displacement - in this task we consider 8 mm. Using the linear interpolation function, we must therefore calculate the given shear stress for the selected horizontal displacement.

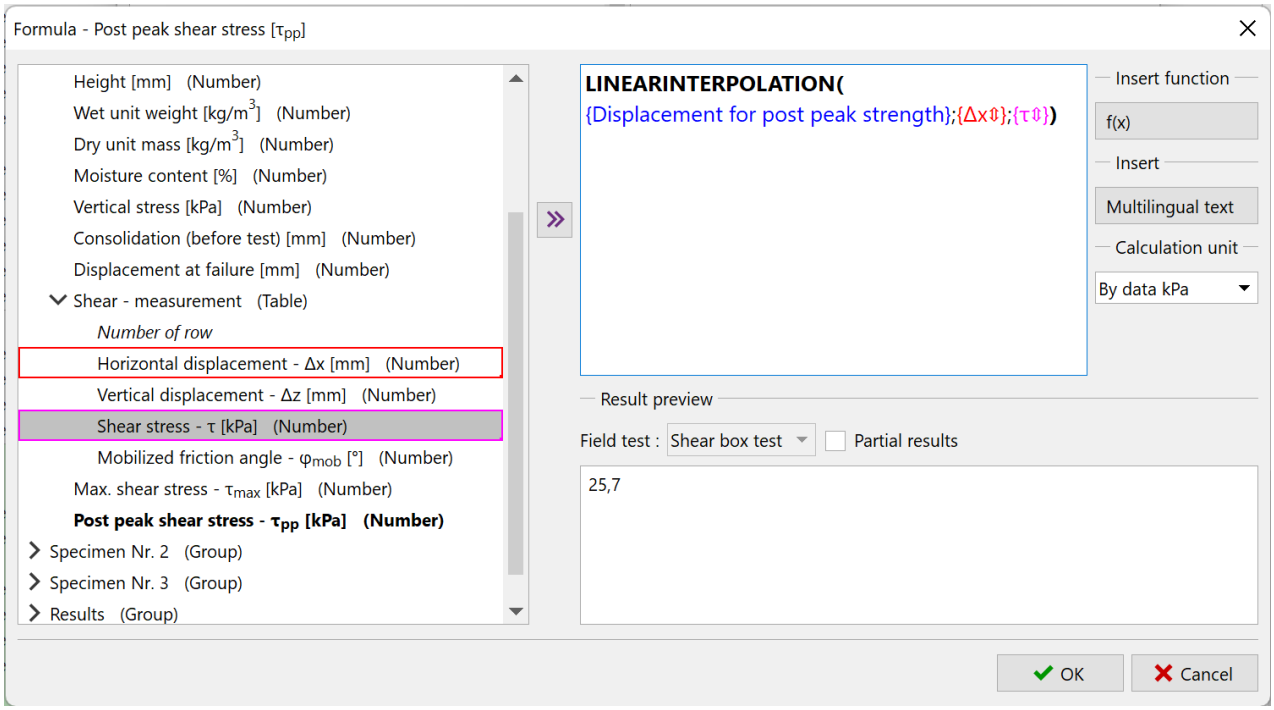
The function can be found in the list under "LINEARINTERPOLATION".

The function calculates the stress value (y) for the specified displacement (x) from the "Shear - Measurement" table.

The variables in the function are:

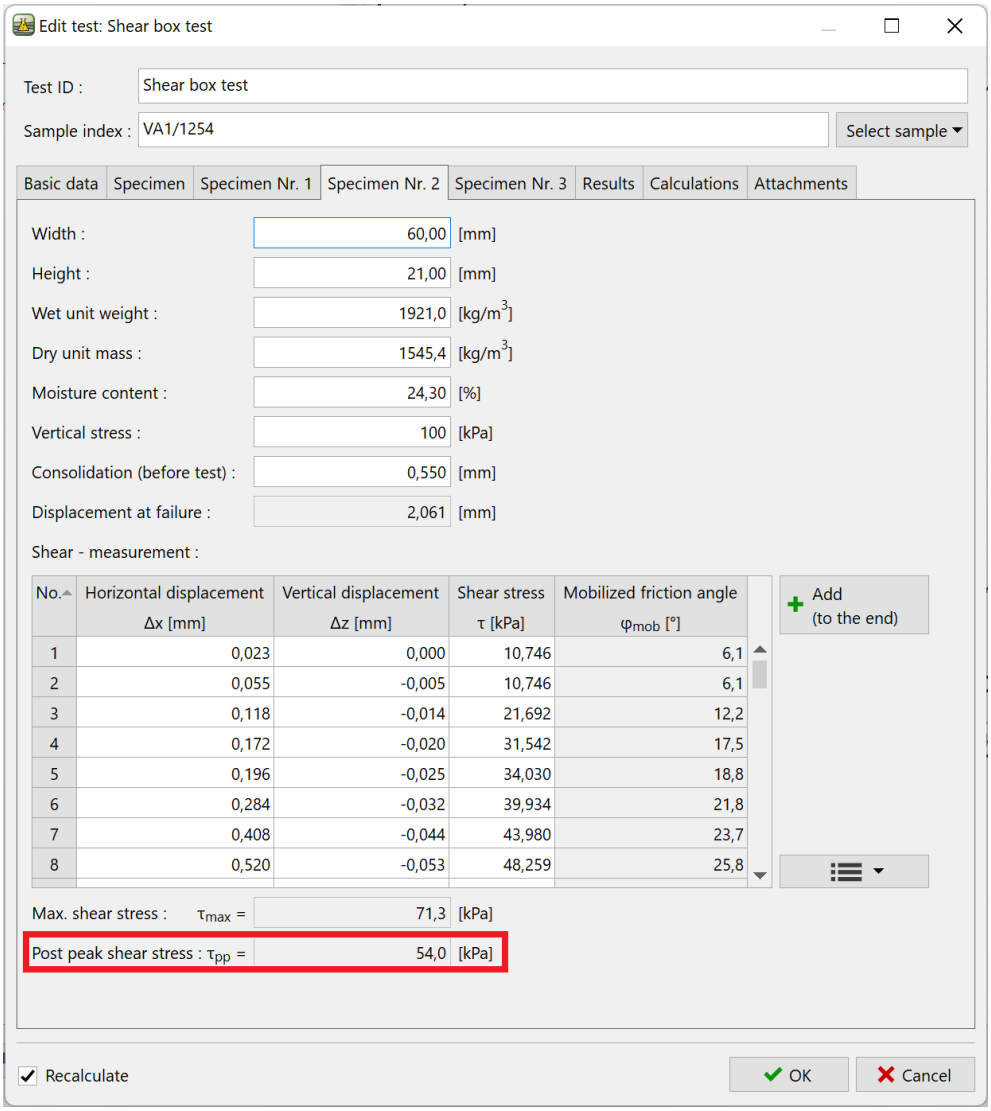
- x – Displacement for post peak strength
- Coordinates x – “Horizontal displacement” in the Shear – measurement table
- Coordinates y – “Shear stress” in the Shear – measurement table

The notation of the function is as follows:



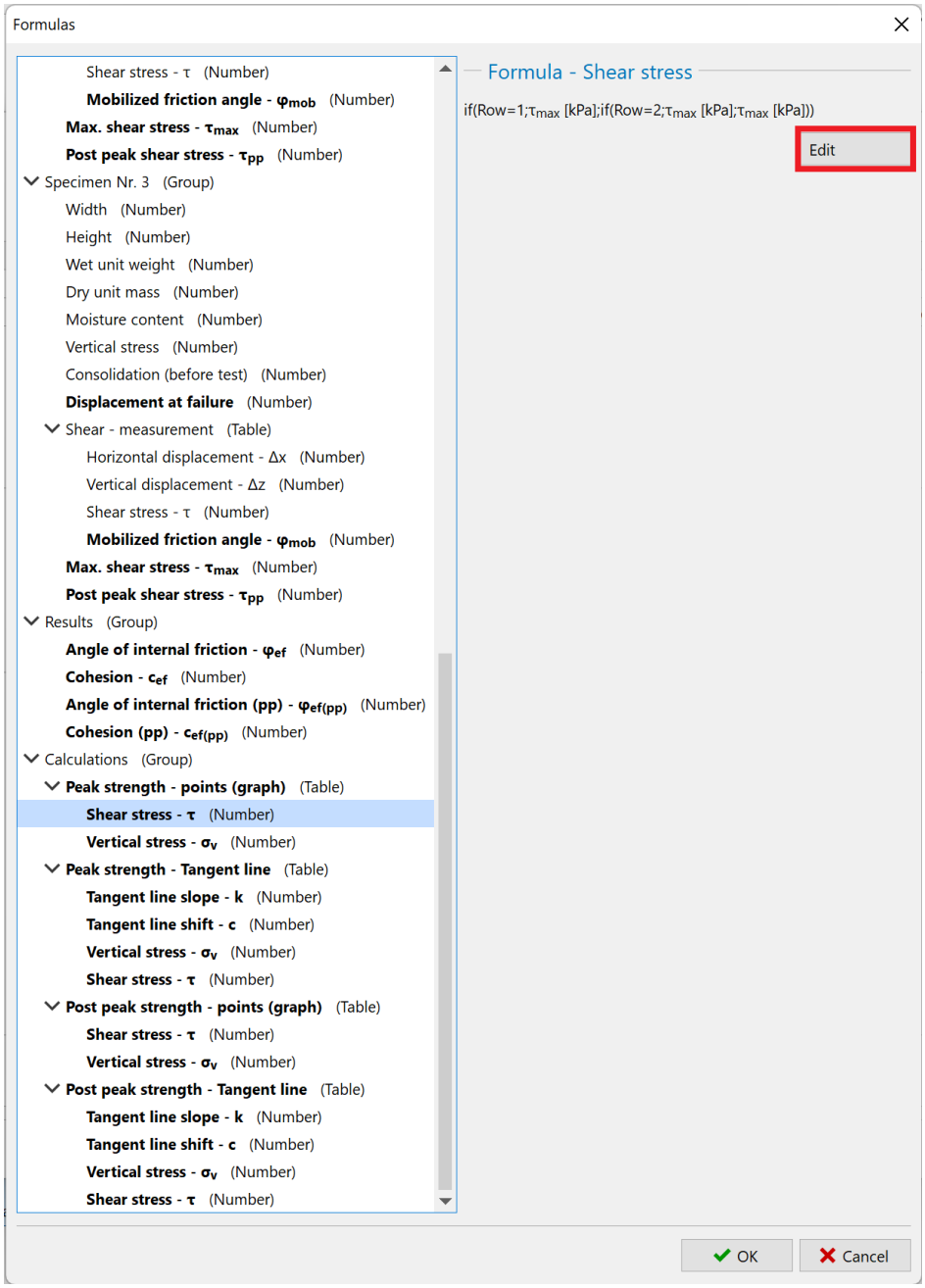
Enter the formulas for the post peak shear stress for specimens 2 and 3 in the same way.

The correctness of the input can be verified at any time in the test input window, where we can see the calculated values of the surface shear stress for our selected displacement of 8 mm.



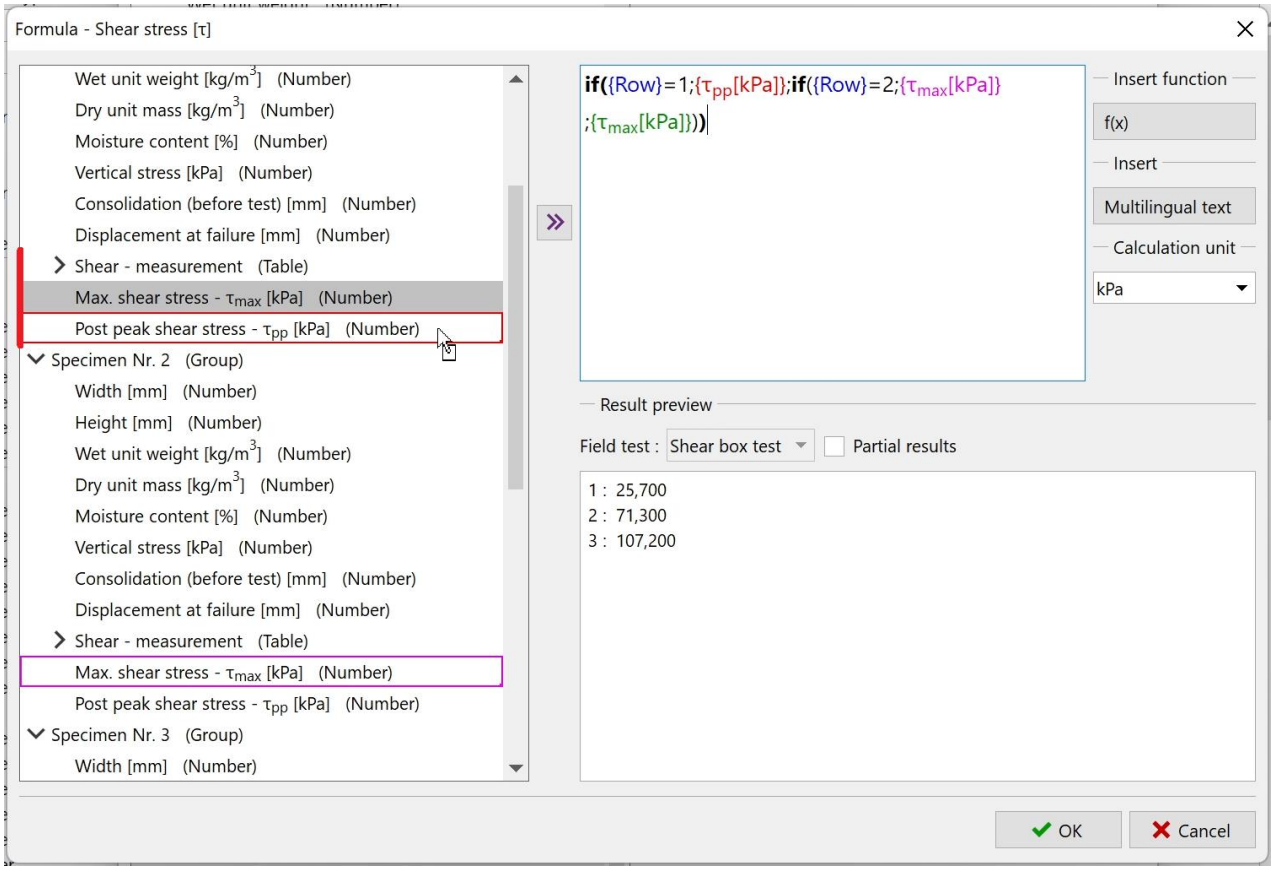
Next, we continue by entering the formulas for plotting the graph. We have prepared two tables in the data. The first plots the points in the graph, the second plots the line (trend line). As we can see in the tree of the formula editing window, the data we copied was copied including the formulas.

We start by editing the table plotting the points. The "Vertical stress" column is the same as the one in the table for the peak parameters, so we don't need to modify it. Therefore we will modify the formula for the "Shear stress" column.

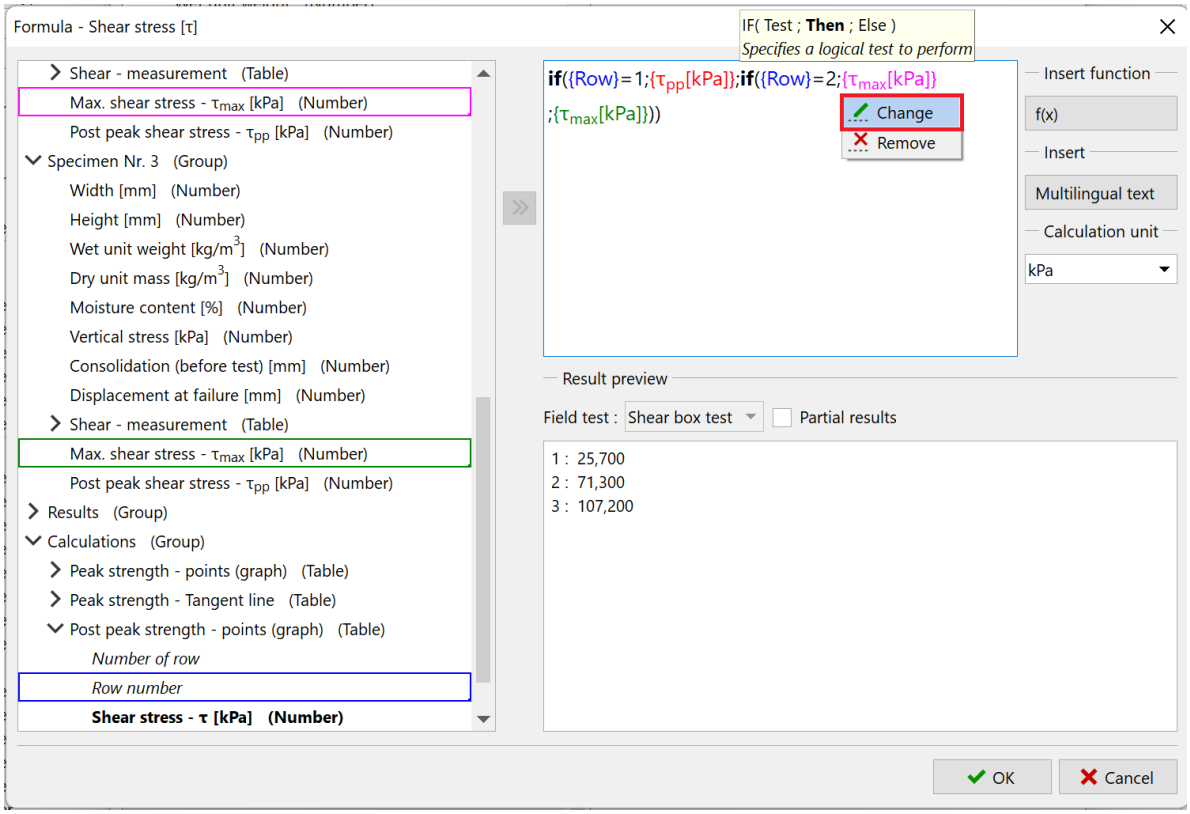


Here we see that we use the IF formula to fill the table in a way, so that the first row of the table is filled with the data of the first specimen, the second row with the data of the second specimen, and the third row with the data of the third specimen.

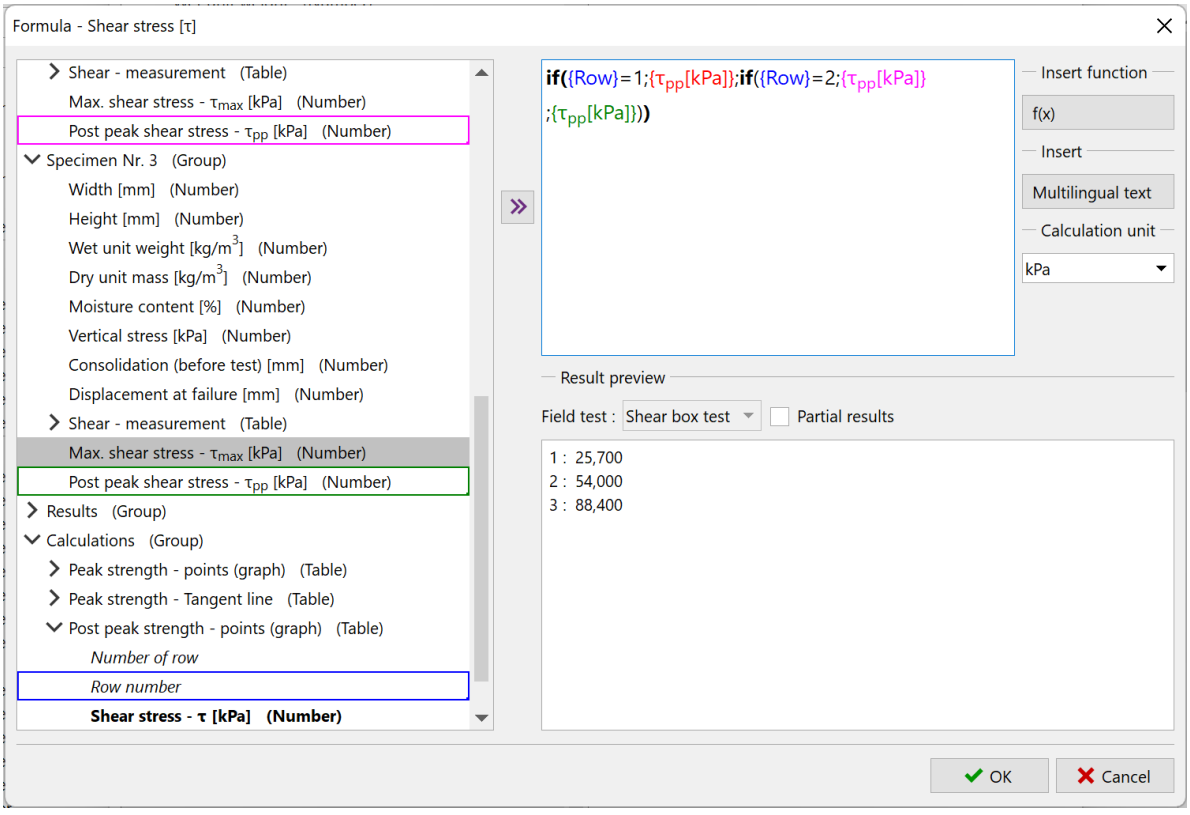
In the formula, we just need to replace the references to Max. shear stress with references to Post peak shear stress, always for the respective specimens. We can do this simply by pressing the left mouse button on the red framed item (which corresponds to the red reference in the formula), holding it down, and moving the mouse to the new item. This will change the link to match the newly selected data type.



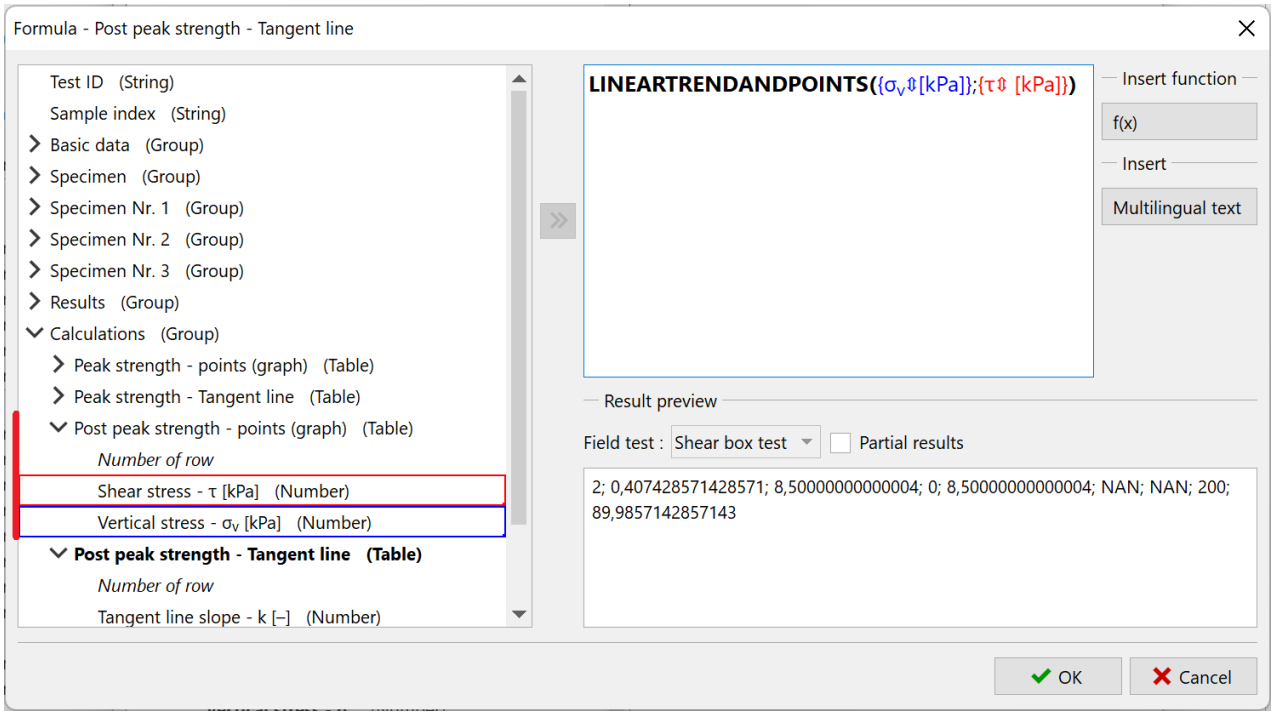
The second option is to right-click on the link in the formula and press the "Change" option to select a new data type from the tree.



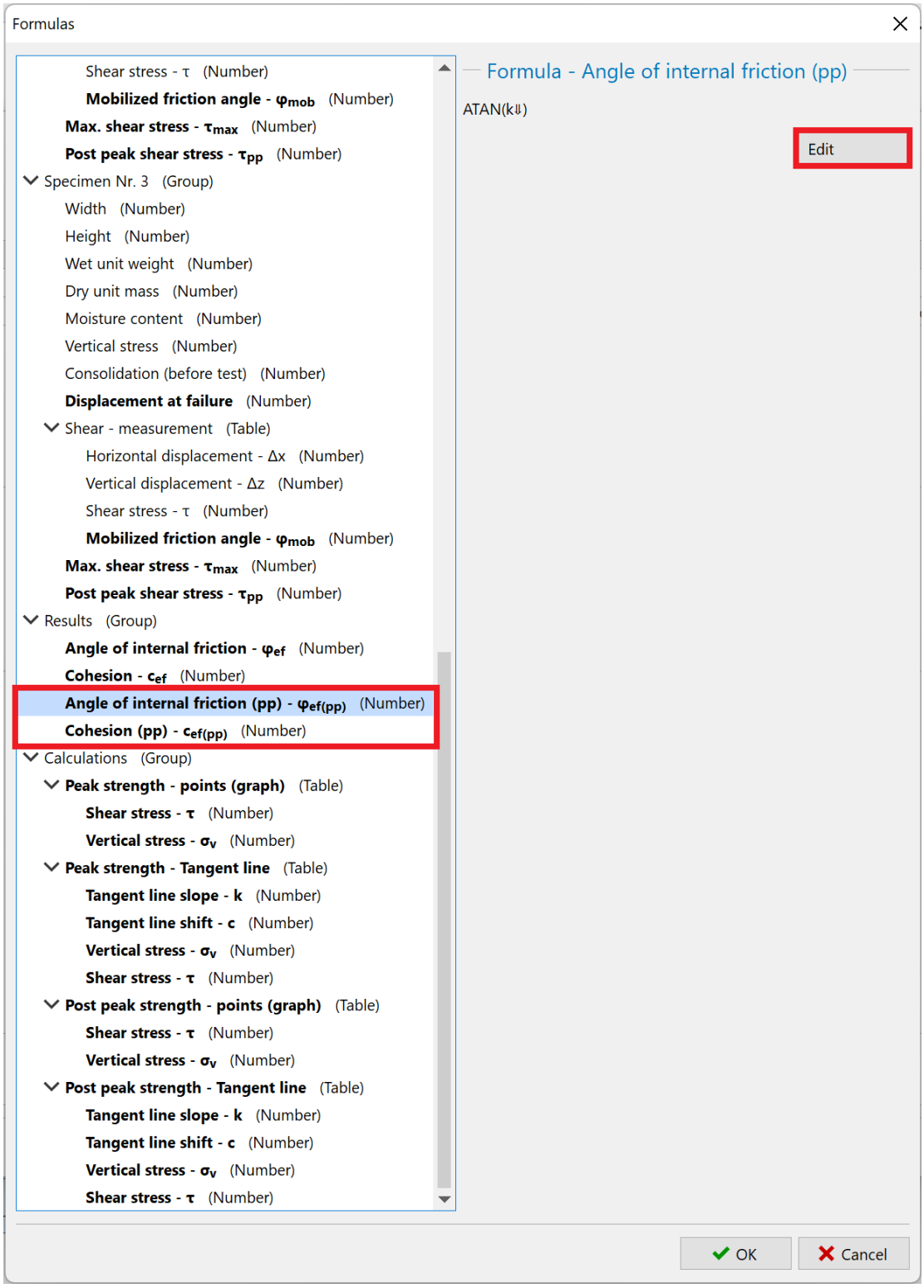
The resulting formula has the following form:



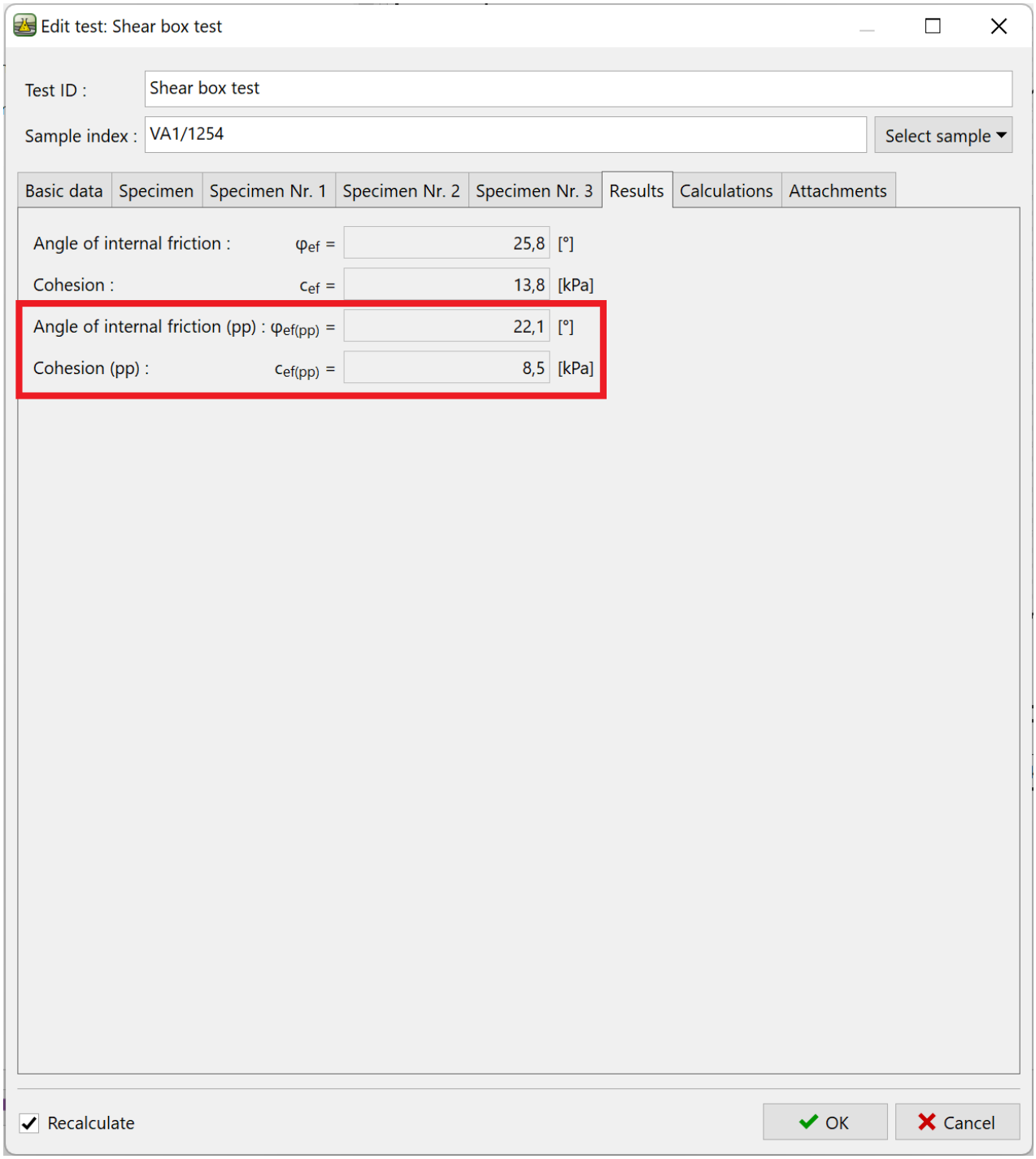
The formula for the trendline should be adjusted automatically when copying. Nevertheless, we open it and check that the data links match the post peak strength.



The final formulas we need to modify are in the "Results" group. In them, again, we just replace the references from the peak strength table to the post peak strength table.



This completes the work with formulas. After returning to the test input window, we can check if the calculated values are correct.

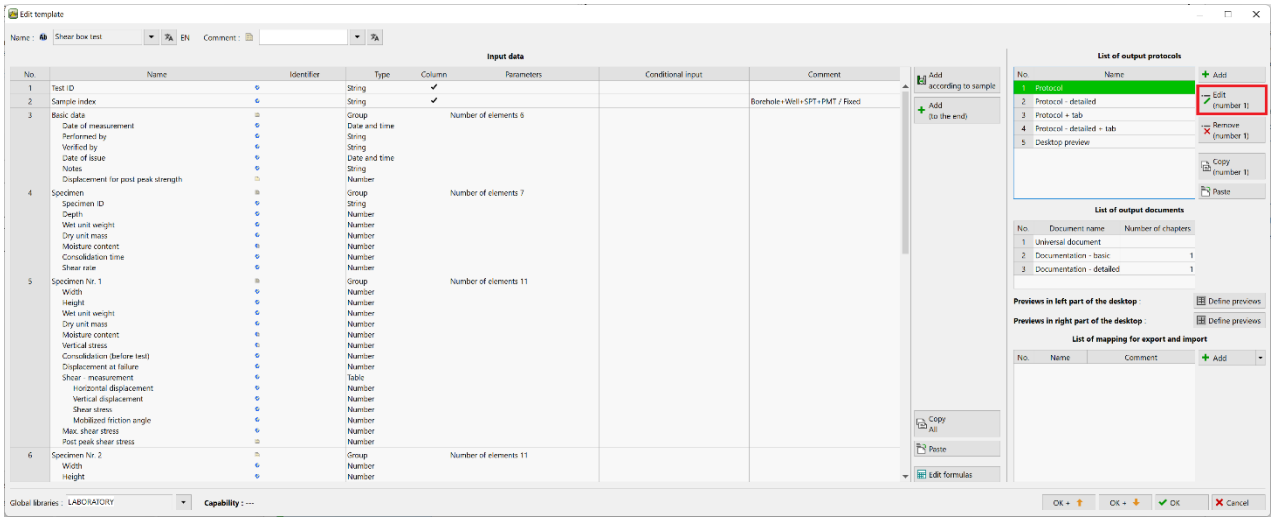


Part 4

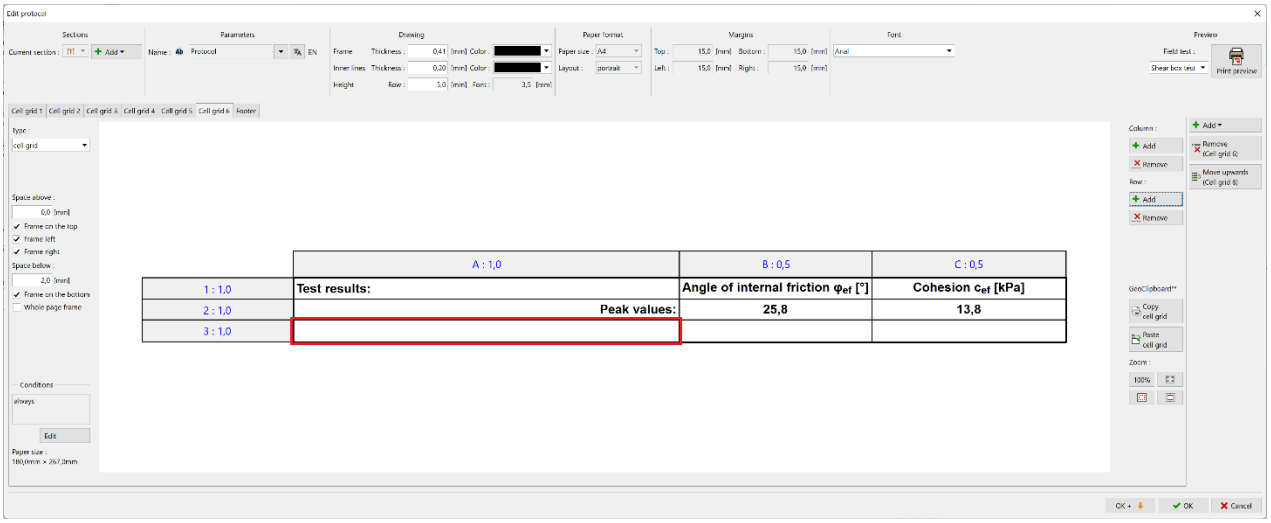
In the next stage, we modify the graph and protocol to include the newly created data.

Note: Basic log editing work is described in Engineering Manual 51.

We'll start by modifying the protocol:

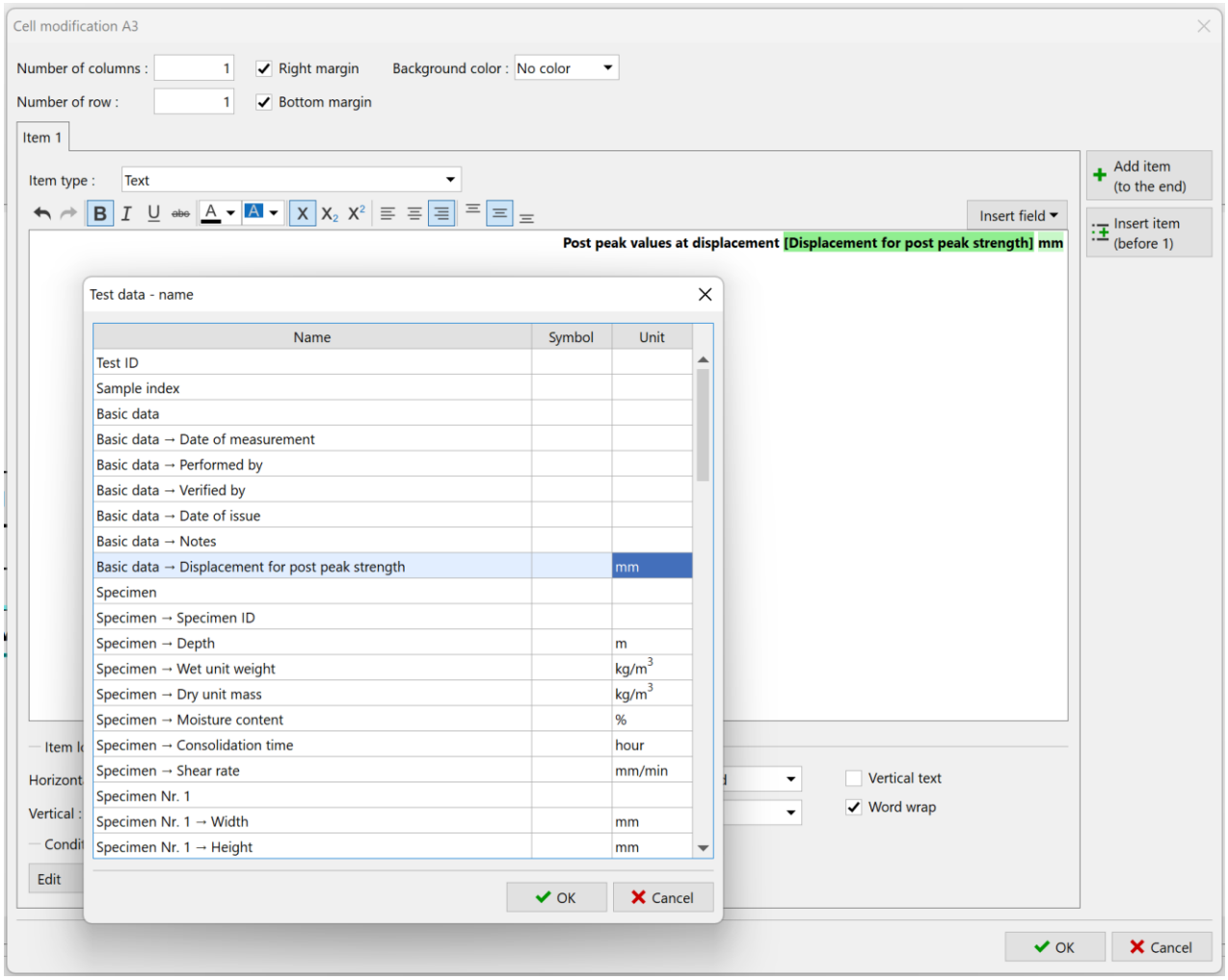


In the "Cell grid 6" tab, where the resulting values are shown, add a row.



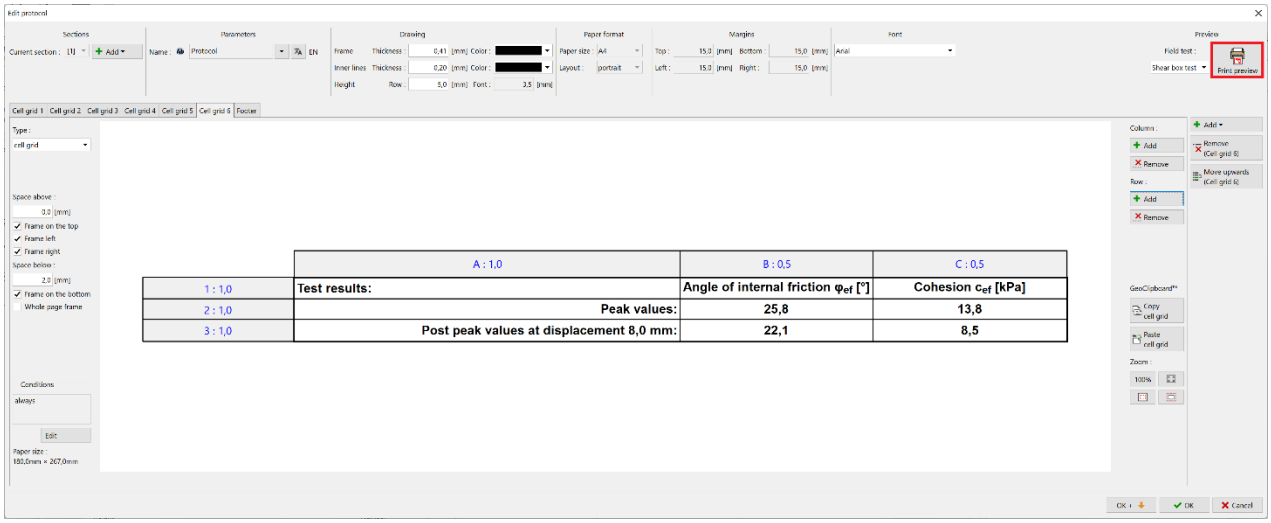
	A : 1,0	B : 0,5	C : 0,5
1 : 1,0	**Test results:**	**Angle of internal friction φ_{ef} [°]**	**Cohesion c_{ef} [kPa]**
2 : 1,0	**Peak values:**	**25,8**	**13,8**
3 : 1,0			

In the newly created cell, type the text "Post peak values at displacement", modify the formatting and add a link to the displacement data type we have chosen. The number itself can be added via the "Test data - data" option, the unit can be added via the "Test data - name" option. This will ensure that if we change the unit in the data to e.g. cm, there will be a change in the output report as well.

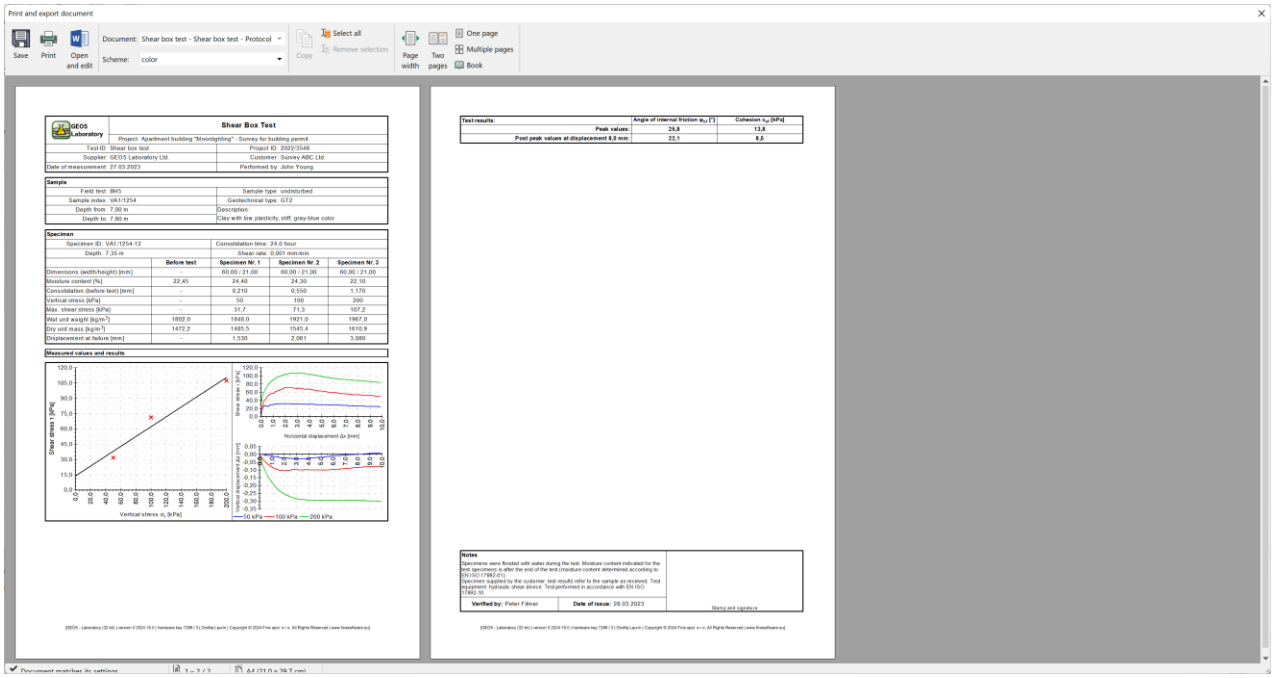


Note: in case we would like to use the protocol in more languages, it is possible to insert "Multilingual text" via the "Insert field" option, where the text can be translated into other languages.

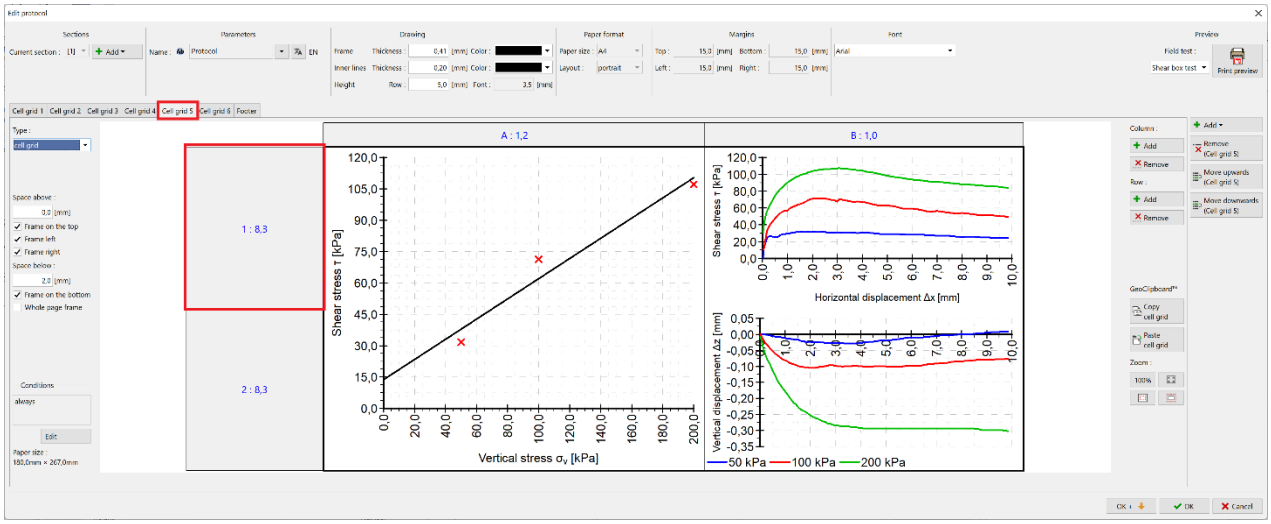
Then insert the corresponding data into the remaining cells. Select "Test data - data" via the "Insert field" option.



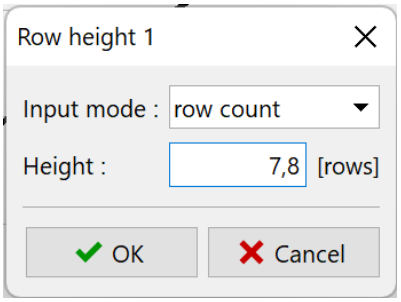
Using the "Print Preview" button, you can view the modified report in print form. Here we can see that since we have added a line, everything no longer fits on one page.



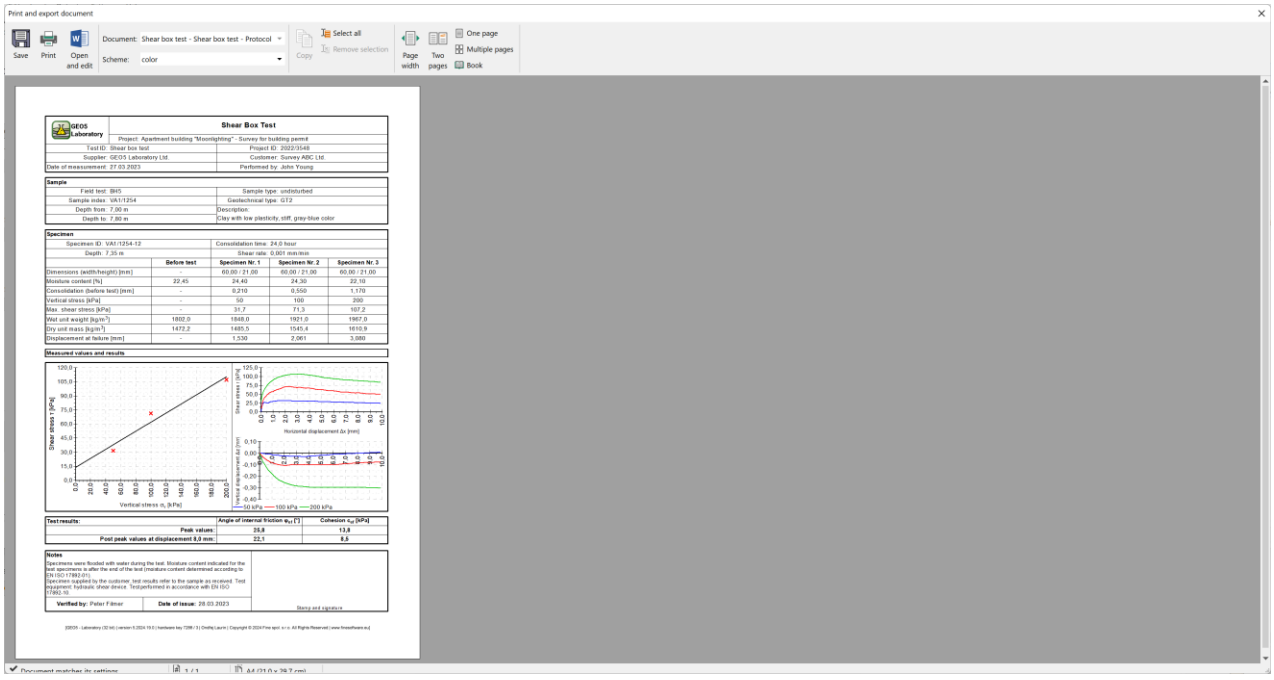
To solve this, for example, reduce the size of the graph in the "Grid cell 5" tab - each row by 0.5.



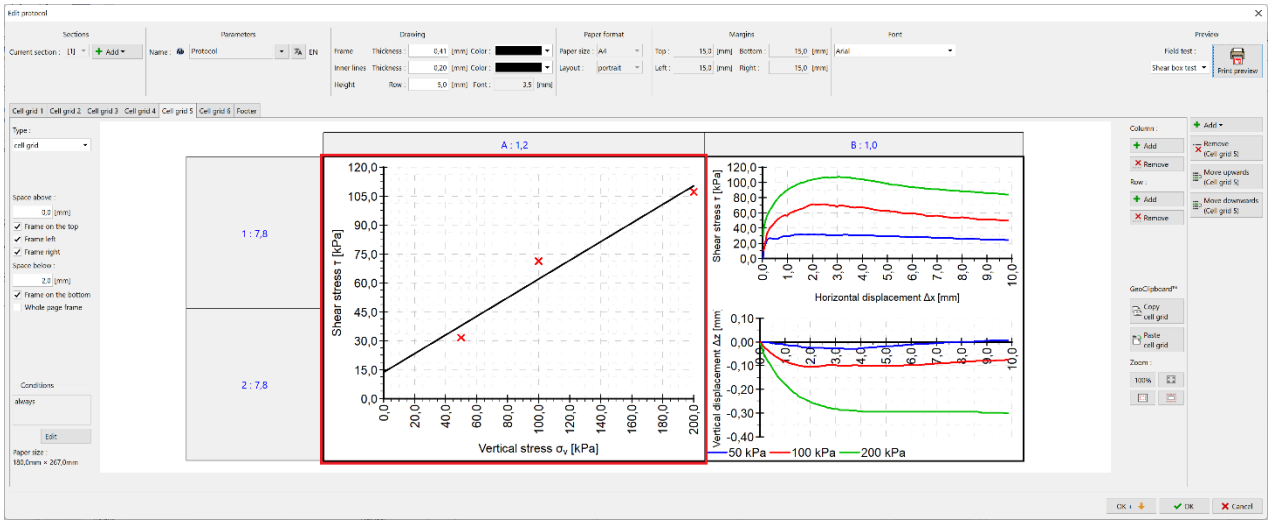
Reduce the size by 0.5 - to 7.8 for both rows.



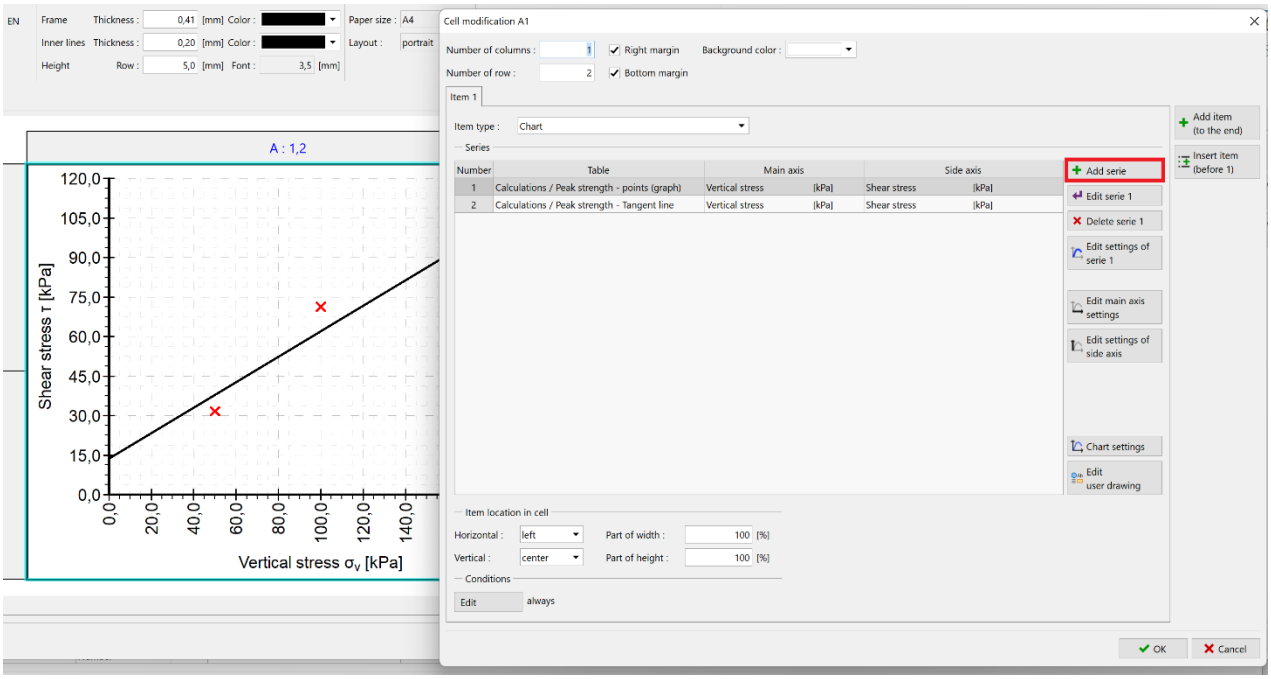
Now we can see that the protocol fits on one page again.



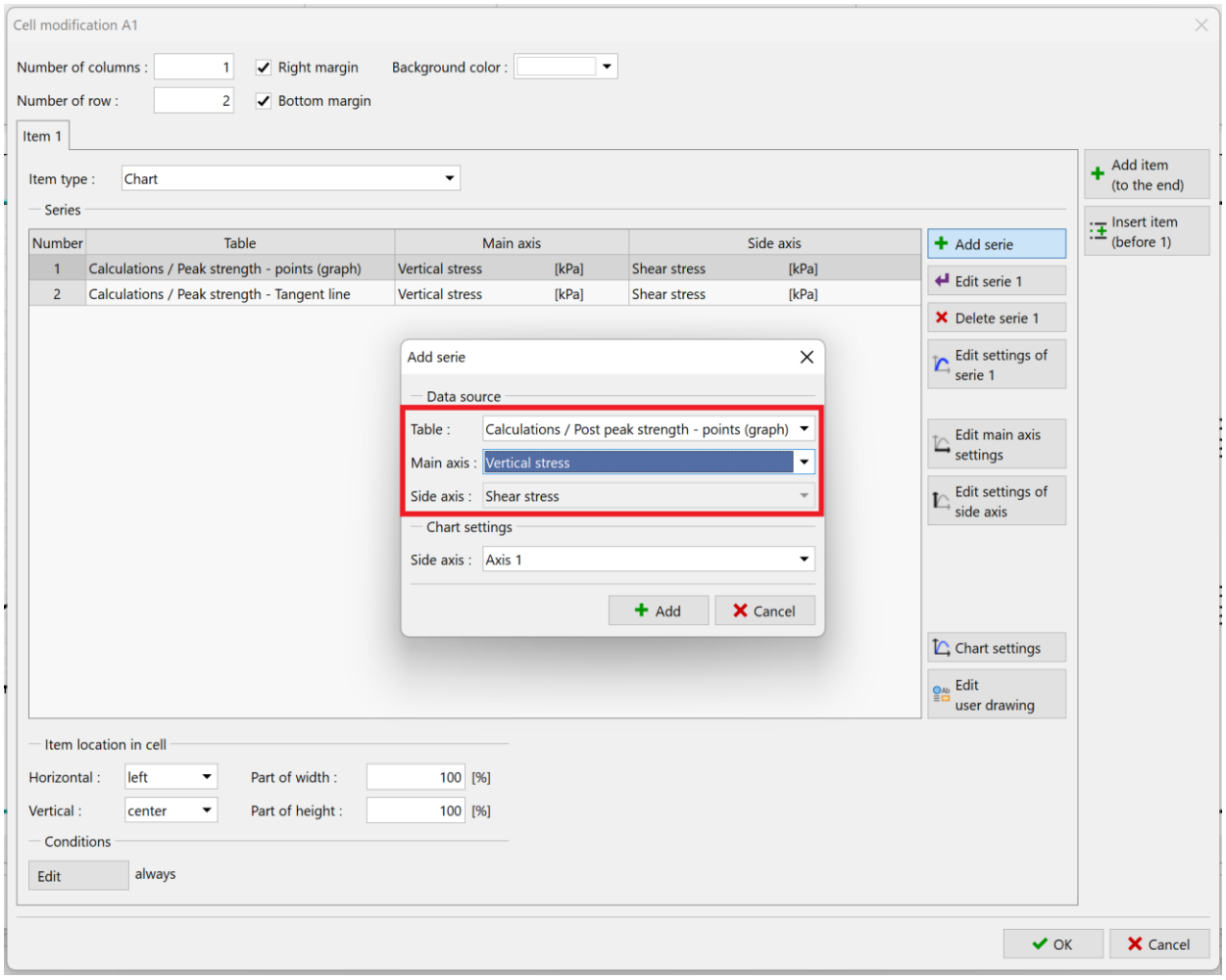
Last remaining task is to add the new data to the graph. Click on the graph and open the editing window.



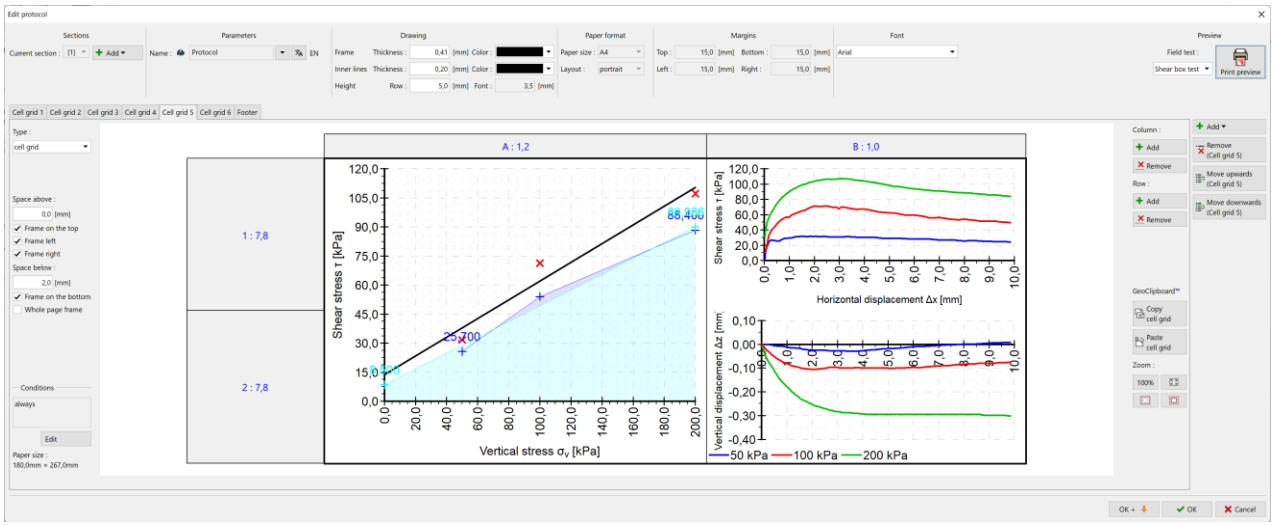
Press the "Add serie" button.



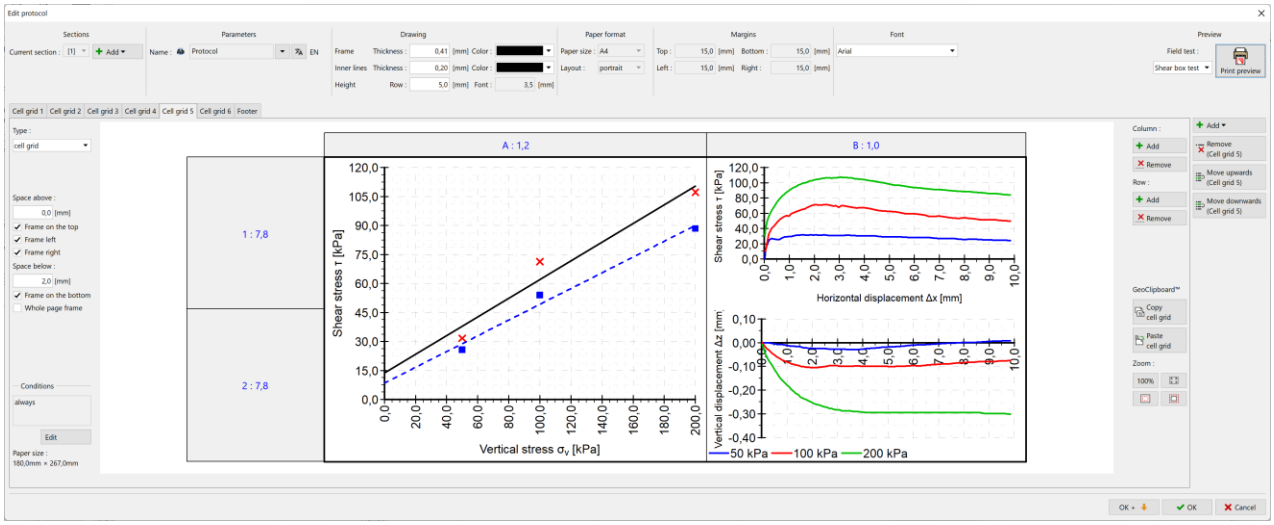
Select the table "Post peak strength - points", the main axis "Vertical stress" and the secondary axis "Shear stress".



Add the post peak strength trendline in the same way. We can see the two new series in the graph:



Finally, we modify the visualization of the two new series to suit our requirements:



Note: The editing of graphical visualization of the graphs is explained in Engineering Manual 51.

This modified protocol corresponds to the specification.

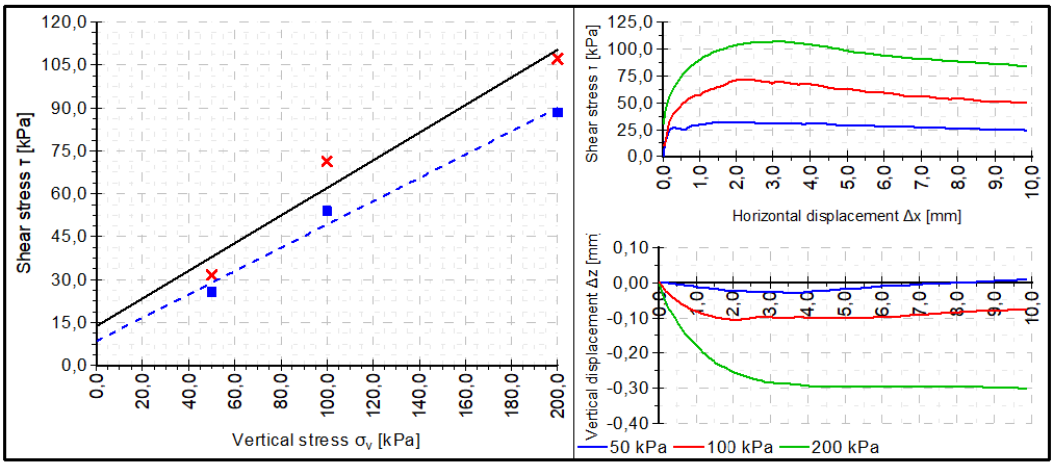
GEO5 Laboratory	**Shear Box Test**
	Project: Apartment building "Moonlighting" - Survey for building permit
Test ID: Shear box test	Project ID: 2022/3548
Supplier: GEO5 Laboratory Ltd.	Customer: Survey ABC Ltd.
Date of measurement: 27.03.2023	Performed by: John Young

Sample	
Field test: BH5	Sample type: undisturbed
Sample index: VA1/1254	Geotechnical type: GT2
Depth from: 7,00 m	Description:
Depth to: 7,80 m	Clay with low plasticity, stiff, gray-blue color

Specimen

Specimen ID: VA1/1254-12		Consolidation time: 24,0 hour		
Depth: 7,35 m		Shear rate: 0,001 mm/min		
	Before test	**Specimen Nr. 1**	**Specimen Nr. 2**	**Specimen Nr. 3**
Dimensions (width/height) [mm]	-	60,00 / 21,00	60,00 / 21,00	60,00 / 21,00
Moisture content [%]	22,45	24,40	24,30	22,10
Consolidation (before test) [mm]	-	0,210	0,550	1,170
Vertical stress [kPa]	-	50	100	200
Max. shear stress [kPa]	-	31,7	71,3	107,2
Wet unit weight [kg/m^3]	1802,0	1848,0	1921,0	1967,0
Dry unit mass [kg/m^3]	1472,2	1485,5	1545,4	1610,9
Displacement at failure [mm]	-	1,530	2,061	3,080

Measured values and results



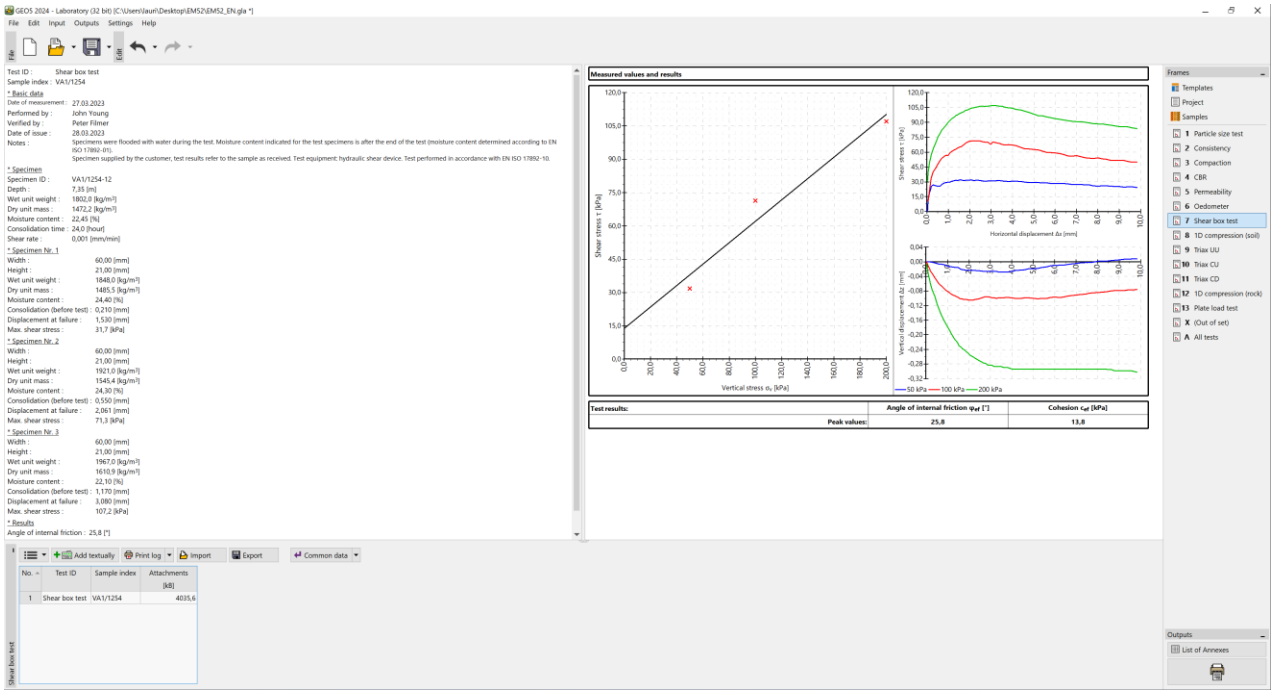
Test results:	**Angle of internal friction φ_{ef} [°]**	**Cohesion c_{ef} [kPa]**
Peak values:	**25,8**	**13,8**
Post peak values at displacement 8,0 mm:	**22,1**	**8,5**

Notes

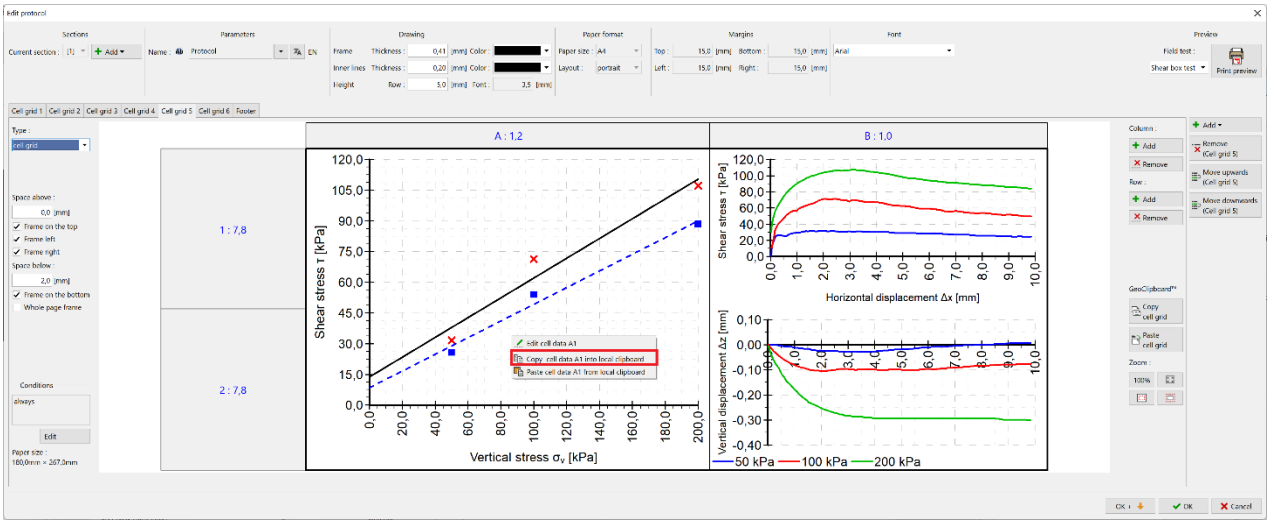
Specimens were flooded with water during the test. Moisture content indicated for the test specimens is after the end of the test (moisture content determined according to EN ISO 17892-01).
Specimen supplied by the customer, test results refer to the sample as received. Test equipment: hydraulic shear device. Test performed in accordance with EN ISO 17892-10.

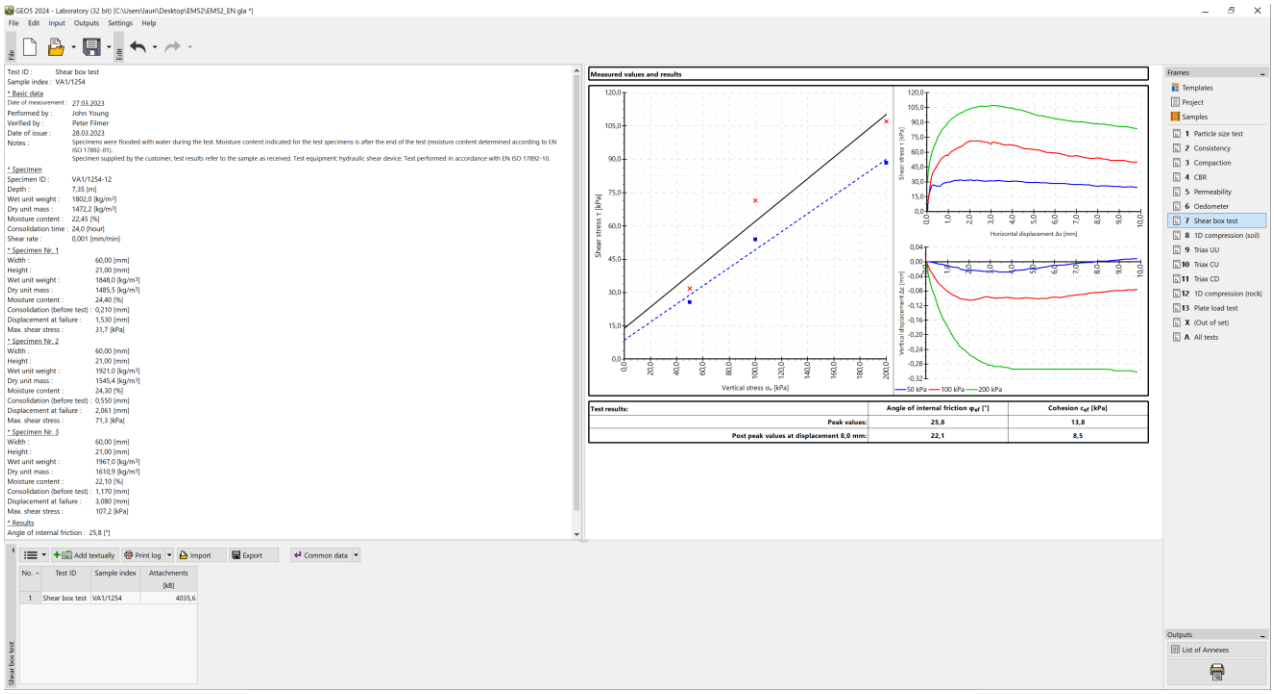
Verified by: Peter Filmer | **Date of issue:** 28.03.2023 | Stamp and signature

However, if we go back to the main program window, we see that the graph has remained unchanged. The graph here is displayed from the output protocol called "Desktop Preview", so we need to modify it as well.



Just copy and paste the graph and the result table into the preview.





Other protocols can be modified in the same way.